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The MONTHLY REVIEW

Published by the
AMERICAN ELECTRO-PLATERS' SOCIETY

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90 Maynard St.
Springfield, Massachusetts

VOL. XX JUNE, 1934 NO. 10

EDITORIAL

THE FUTURE OF THE A. E. S.

THE annual convention of the American Electro-Platers' Society in Detroit this month should be an epoch making event. Three years of depression in industry have made it necessary for many of our branches to revise their membership lists and clean house. Many names have been dropped for obvious reasons, and it will be necessary for our organization to proceed at once with a great membership campaign. Every person wishing to join the A. E. S., regardless of the position he holds, should be admitted to membership. This is the secret of the success attending other societies such as ours, and we should follow their example even if we have to discard our antiquated by-laws, some of which have no place in a progressive organization as ours is supposed to be. It is earnestly hoped that the executive committee will sponsor an intensive drive to double our numbers which should be started immediately after the convention closes, revising our by-laws to include assistant foremen, and all others interested in the plater's art.

The research committee should be put on a stable basis with all uncertainty removed. There are men in our membership big enough to direct this committee successfully if we give them our support. Manufacturers will give moral and financial aid if they realize that the A. E. S. really means to conduct a research department that is worth while. The work of this department has never been presented to the rank and file of our supporters of research in an able and business-like way, and in the last few years we have not had at the head of this committee men who could spare the time to do full justice to bringing value of the research department to the attention of the men most interested. Let us forget the big bad wolf and choose a man from our membership who will study our research problems and lead us from this period of uncertainty to achievement and success. Remember we still have Dr. Blum's invaluable assistance at the Bureau and we must continue the study of the exposure tests at Key West, Sandy Hook, Pittsburgh, and Washington.

The Bureau of Education under Mr. T. Slattery has done a fine job. The Tingley articles have been widely read, not only

by our members, but by plant executives, and many suggestions contained therein have been put into practice in some of our large manufacturing concerns. In this connection, also we wish to thank our good friend, Dr. Sanigar, of Philadelphia Branch, along with Mr. Slattery, for their splendid contributions to the Abstract Section of the REVIEW. The Education Bureau is well equipped to cope with any situation that may arise, even if our membership should increase beyond our fondest expectations.

The hands of the Editor are tied because of the by-laws limiting the sending of the REVIEW to members only. In our files we have dozens of letters from some of our best known manufacturers in America asking us to place them on our mailing lists and willing to pay for the privilege. How can we let our light shine? How can we expect to grow if we are to continue to be so hidebound and narrow in our viewpoint to permit this fool thing called sentiment to exist any longer? That great document the Constitution of the United States has had many amendments. It is to be hoped that our constitution, worthy as it may have been years ago, is not so infallible that it cannot be amended to make it applicable to the needs and requirements of the era in which we live. Give the Editor the privilege of broadcasting the doings of the Platers' Society to the four corners of the earth through the pages of the "REVIEW", and watch the results in increased membership and advertising that pays. We need more branches! Vast industrial areas have not been reached by the platers' organization; we have a golden opportunity to establish new branches in different parts of the country now that plating is coming back to its own. Are we equal to the task that confronts us?

In conclusion support your officers. They are your representatives and are worthy and well-qualified. They carry the burden of their positions during the year with loyality and devotion. The year ahead of us may determine our future. We cannot continue much longer as an organization if we fail to grasp the opportunities and possibilities that present themselves under the new conditions now existing. Let us give serious consideration to these all important questions and go to the convention prepared to take a firm stand when the time comes for action.

The future of the A. E. S. is in our hands. May we have no regrets as the 1934 convention closes. As the newly elected officers start to function may they have a new program and a united organization to support them all through the year.

CONVENTION PROGRAM

Educational Session

Monday — June 11, 1 *P.M.* E. Steen Thompson, *Chairman*

1. "Summary of Researches on Plating at the Bureau of Standards"— Dr. W Blum, Bureau of Standards, Washington, D. C.
2. "Complete Report of Exposure Tests on Plated Steel with Recommendations"— P. W. C. Strausser (Research Associate for the A. E. S.) and Dr. W. Blum.
3. "Plans for Investigating the Plating of Non-Ferrous Metals"— Dr. W. Blum.
4. "Testing of Plated Metals for Compliance with Federal Specifications"— M. R. Thompson, Bureau of Standards.
5. "Formal Discussion of Mr. Thompson's Paper"— by Wm. M. Phillips, General Motors Corp., Detroit Chairman, Joint Committee on Specifications for Plating.

Tuesday — June 12, 9 *A.M.* T. F. Slattery, *Chairman*

1. "Nickel Plating"— Mr. Ray Goodsell (Milwaukee Branch, A. E. S.), Racine Plating Works, Racine, Wis.
2. "Bright Nickel Plating"— L. E. Eckelmann, Pyrene Manufacturing Company, Newark, N. J.
3. "Relation of Coating Thicknesses to Service Life on Zinc Die Castings"— E. A. Anderson, New Jersey Zinc Company, Palmerton, Pa.
4. "Ductility and Adhesion of Nickel Deposits"— F. P. Romanoff, Apollo Metal Works, LaSalle, Ill. (Electrochemical Society Meeting, Asheville, N. C., Apr. 26, 1934.).

Tuesday — June 12, 8 *P.M.* Dr. W. Blum, *Chairman*

1. "Detergent Properties of Alkalies, Part I, Plating Room Cleaners", N. Promisel, Research Electrochemist, International Silver Co., Meriden, Conn.
2. "Pictorial Study of Plating Conditions"— Wm. M. Phillips, Research Engineer, General Motors Corp., Detroit, Mich.
3. "Does Chemical Control of Plating Solutions Solve the Electro-platers' Problems?"— Geo. B. Hogaboom (Newark Branch, A. E. S.), Research. Engineer, Hanson-Van Winkle-Munning Co., Matawan, N. J.

Wednesday — June 13, 9 *A.M.* Walter S. Barrows, *Chairman*

1. "Recent Progress in Industrial Cleaning"— R. W. Mitchell, Magnus Chemical Company, Garwood, N. J.
2. "Plating Plant Layout"— A. J. Lupien (Detroit Branch A. E. S.), Udylite Process Company, Detroit, Mich.

3. "Copper Cyanide Plating, Its Peculiarities"— Elmer Woodmansee (Detroit Branch A. E. S.).
4. "Concentrated Cyanide Plating Baths"— Dr. L. E. Pan, U. S. Research Corp., Long Island City, N. Y.

Thursday — June 14, 1 *P.M.* Wm. M. Phillips, *Chairman*

1. "Rust Proofing before Color Finishing"— R. R. Tanner, Metal Finishing Research Corp., Detroit, Mich.
2. "Rubber in the Plating Industry"— R. H. Kittner, American Hard Rubber Co., Akron, Ohio.
3. "Some New Developments in Buffing Compositions"— Geo. M. Cunningham, National Oil Products Co., Harrison, N. J.
4. "Chromium Plating on Sheet Zinc"— Chas. H. Proctor (New York Branch A. E. S.), Founder of the Society.

FABRICATED METAL PRODUCTS FEDERATION
Washington, D. C.

TO ALL TRADE ASSOCIATION SECRETARIES:

You have received from the Federation and this Code Authority several bulletins regarding the required posting of labor provisions of the Basic Code in the plants of all manufacturers whose operations fall under our Code. This same information has gone to all members of the industry known to us. However, you will appreciate that there is no complete list available, insofar as a wide search has so far developed.

Because of the penalties involved and of the desire of most manufacturers to comply fully with NRA requirements, it is highly important to the Administration, to the Code Authorities and to Trade Associations that posting provisions should be known to all manufacturers. In a letter, in this regard, to Code Authorities and Code Committees, dated March 20, 1934, William H. Davis, National Compliance Director, states, "every effort should be made to reach those members not on the mailing list, through publicity in trade journals and other media. This publicity should acquaint the members with their obligations under the posting regulations, and indicate where application forms may be obtained."

Since your orgainzation and many of your members have contacts with the "various trade journals and other media" applying to your particular sub-division or sub-divisions of industry, will you cooperate with the Administration, the Federation and the

Code Authority by asking such publications to publish, for the benefit of industry, a news item, in substance, somewhat as follows:

"Regulations Governing Posting of Official Copies of the Labor Provisions of Approved Codes"

"Attention of all manufacturers is directed to President Roosevelt's Executive Order of February 8, 1934, and General Johnson's regulations of February 12, 1934, to the effect that all manufacturers must post in their plants official copies of labor provisions of all NRA codes under which they operate. To quote the exact language of NRA —'A separate application must be made to the Code Authority established under each Code to which you are subject, on or before May 15, 1934, or within forty-five (45) days from the effective date of the Code, or the date upon which you become subject thereto, whichever is latest. Applications must state the number of official copies needed in order to carry out the requirement that official copies shall be "posted conspicuously and in sufficient number to make them freely and conveniently accessible to all employees - - -". Furthermore, if you have made application for official copies of the labor provisions of a Code and thereafter engage in operations subject to the same Code in any additional shop, establishment, or separate unit, you must make a supplemental application within ten (10) days of so doing. If you operate a number of establishments under a single Code, you need make only one application, but should estimate the number of posters needed for all establishments.'

National Code Authorities are mailing government application forms to the manufacturers on which they are to apply for such posters directly to the Code Authorities under which they operate. The Administration desires to reach all known manufacturers and since there is a penalty involved for failure to comply with posting regulations, manufacturers who have not received such forms should obtain same without delay. Should your plant operate wholly or in part under the Basic Code of the Fabricated Metal Products Manufacturing and Metal Finishing and Metal Coating Industry, you should apply to that Code Authority, 729 - 15th Street, N. W., Washington, D. C. Where other codes are involved, the appropriate Code Authority should be addressed."

If you can assist in securing the wide publicity desired in this important phase of NRA administration, your cooperation will be appreciated fully by the Federation and no doubt by the Administration. In our opinion such action will constitute a real service which trade publications may offer their readers. If you are in a position to take any steps in this direction, will you please let us know what you have done?

CODE AUTHORITY for the
Fabricated Metal Products Manufacturing and Metal Finishing and Metal Coating Industry

H. S. KIMBALL, *Chairman.*

NOTES ON CYANIDE SOLUTIONS

Richard M. Wick (Read by Dr. William Blum)

Read at Chicago Convention 1933

I. INTRODUCTION

Most of the quantitative studies on electroplating solutions have been made on acid or nearly neutral baths, such as the nickel, chromium, acid copper and acid zinc baths. Such results as have been reported on cyanide solutions have shown that they are unstable and that it is difficult to obtain reproducible values for the potentials and other properties. As the decomposition of the solutions may give rise to compounds which change the properties and effect the operation of the baths, knowledge of such changes is necessary before reliable measurements can be made. Such a study in turn depends upon the ability to analyze the solutions for both common and unusual constituents.

The work conducted at the Bureau of Standards on cyanide solutions has thus far been devoted to these general problems, rather than to the operation of a specific solution such as the silver plating bath. It is hoped and believed that the knowledge and experience thus gained will expedite and improve the study of the deposition of specific metals. The following notes summarize the important points thus far studied, in addition to those previously reported.

EXPERIMENTAL RESULTS

A. Decomposition of Cyanide Solutions:

The well established fact that the cyanide in plating solutions does decompose is brought home to the plater by the necessity of regular additions of alkali cyanide to the bath. The plater knows that as the cyanide disappears the concentration of carbonate increases, sometimes to such an extent that it must be removed by some means. Decomposition in plating solutions is more complex than this statement would indicate. More than is required by the decomposition alone must be added to maintain a given cyanide concentration, because of the appreciable loss by "drag-out," and because of concentration changes, especially of metals other than the metal being plated. Metals that remain in solution are combined with some cyanide, so that this amount is lost, and fails to appear in the analysis for free cyanide. It is easy to see that if in a given time the cyanide content of the solution diminishes and the content of a foreign metal (such as copper in a

silver bath) increases, then some of the apparent loss is due to the cyanide needed because of the increased concentration of that metal.

A preliminary report on the chemical decomposition was given to this Society at the Annual Convention in 1932. Since that time the work has been considerably extended. A brief summary of some of the conclusions reached, including those presented in the previous report, may be of interest. The chemical and electro-chemical reactions that are of importance in accounting for the loss of cyanide are as follows:

1. Cyanide hydrolyzes at all temperatures according to the chemical reaction

$$KCN + H_2O = KOH + HCN$$

potassium cyanide + water = potassium hydroxide + hydrocyanic acid (This and subsequent reactions can be written equally well with the corresponding sodium compounds). This equation means that whenever cyanide is dissolved in water there is immediately formed a certain amount of hydroxide (alkali) and a certain amount of hydrocyanic acid *in solution*. The amount that is formed is very small, and corresponds to about one-half of one per cent of the cyanide added. When the dissolved hydrocyanic acid evaporates from the solution (as a gas) more of the cyanide decomposes to preserve the balance or equilibrium corresponding to the equation. Similarly, when the hydroxide is removed to form carbonate, additional amounts of cyanide decompose to maintain the equilibrium.

2. Carbon dioxide (carbonic acid) from the air reacts with the hydroxide formed in (1) and accelerates that reaction.

$$KOH + H_2CO_3 = K_2CO_3 + H_2O$$

potassium hydroxide + carbonic acid = potassium carbonate + water. Almost all of the carbonate that is formed in the cyanide plating solution was originally present in the air as carbon dioxide. This reaction is fairly slow, but it is going on continuously, so that over a long period of time very large amounts of carbonate can be formed. The carbonate that is formed has no effect on the first reaction, but the process of its formation, that is, the removal of hydroxide, causes this reaction to progress further. Hence, equivalent amounts of cyanide are decomposed as carbonate is formed.

3. When cyanide solutions are used hot, for example, above 45°C (113°F), the cyanide undergoes a second type of hydrolysis

at an appreciable rate. This is:

$$KCN + 2H_2O = HCOOK + NH_3$$

potassium cyanide + water = potassium formate + ammonia.

This reaction accounts for the smell of ammonia sometimes observed when a closed bottle of old cyanide solution is opened. The amount of cyanide which decomposes in this way increases very rapidly as the temperature rises.

4. The potassium formate produced according to (3) is stable in solution, but decomposes under the oxidizing conditions at the anode to form water and carbon dioxide, which in turn produced carbonate in these alkaline solutions. The reaction is:

$$HCOOK + O + KOH$$

potassium formate + oxygen (anodic) + potassium hydroxide =

$$H_2O + K_2CO_3$$

water + potassium carbonate.

5. Cyanide itself, when the current density is high, can be oxidized at the anode to form cyanate.

$$KCN + O = KCNO$$

potassium cyanide + oxygen (anodic) = potassium cyanate. The formation of cyanate by this means was observed in a silver plating bath when the current density was so high (20 amp/sq. ft.) that a black anode scum (probably silver peroxide was formed). In this case it is well known that the anode current efficiency drops below 100 per cent. At a low current density (for example 2 amp/sq. ft.) no cyanate was formed; this is in accord with the common observation of 100 per cent current efficiency for the solution of silver.

6. The cyanate can decompose to form carbonate and ammonia.

$$KCNO + H_2O + KOH = K_2CO_3 + NH_3$$

potassium cyanate + water + potassium hydroxide = potassium carbonate + ammonia.

7. Cyanate can also form urea in the presence of ammonia

$$NH_4CNO = H_2NCONH_2$$

ammonium cyanate = urea

The amount of urea formed in cyanide solutions containing cyanate is extremely small; a trace of this material has, however, been definitely identified.

In these solutions, there can therefore be formed by chemical reactions involving the cyanide the following substances: alkali hydroxide, hydrocyanic acid, carbonate, ammonia, formate, cyanate, and minute amounts of urea.

B. Constitution of Metal Cyanides in Solution:

The free alkali cyanide in a plating solution is usually estimated by titration with silver nitrate solution, using potassium iodide as indicator. The purpose of the potassium iodide is to cause the endpoint, which is the appearance of a permanent precipitate, to appear always at a definite, very small concentration of cyanide ions. By this means reproducible results are obtained even with impure solutions.

The amount of free cyanide thus found does not necessarily represent the concentration which is actually present in the plating solution. This is because it is assumed that the metal complex cyanide exists in the bath in exactly the same form as it does at the endpoint of the titration, while actually this is not usually the case. This fact does not alter the utility of analysis for the control of the solution. On the other hand, substantial scientific progress can not be made until accurate knowledge of the constitution of the metal compounds in cyanide solutions is available.

It was found that the decomposition caused by passing air through a solution made from potassium cyanide and crystallized potassium argentocyanide, $KA_g(CN)_2$ (a definite crystalline compound) was less than in a solution of the same amount of potassium cyanide alone. This means that in the presence of potassium cyanide, the silver present in the solution was combined with more cyanide in its complex than is indicated by the formula $KA_g(CN)_2$. From data obtained in 1904 by Bodländer and Eberlein on the electromotive force of concentration cells of cyanide and silver cyanide complexes, we have calculated the mathematical relationship between the concentration of cyanide ions and the two complex ions of silver and cyanide, namely, $A_g(CN)_2^-$ and $A_g(CN)_3^=$. The equation obtained shows that some $A_g(CN)_3^=$ ions are always present and that the ratio of the concentrations of silver in the two forms depends on the amount of cyanide present.

From this relation the amount of free cyanide actually in a specific solution, prepared from known amounts of the crystallized $KA_g(CN)_2$ and potassium cyanide, was calculated. Then this solution and another solution, containing only potassium cyanide in the amount calculated according to this relationship, were decomposed under standard and reproducible conditions. The amount of decomposition which was found in both cases was

the same, thus proving the validity of the relationship which was derived.

We have therefore been able to show how silver behaves in a cyanide solution and to establish the mathematical law which it follows. Other metals form cyanides of similar types, and it is to be expected that they too obey similar laws, though not necessarily such a simple one. This is a promising direction for studies on the constitution of other cyanide solutions.

C. pH Measurements in Cyanide Solutions:

As indicated by the discussion under *A*, all cyanide solutions are alkaline, that is, they contain more hydroxyl than hydrogen ions. The carbonate that forms is also alkaline, and if (as in zinc baths) alkali hydroxide is also added, the pH is relatively high. It is probable that most cyanide plating solutions have a pH between 10 and 14.

Some exploratory work has been done in this laboratory on the determination of pH in cyanide solutions. A few tentative conclusions can be recorded. The utility of pH measurements in cyanide solutions is an open question at this time and can only be determined by an appropriate investigation. As indicated in "Principles of Electroplating and Electroforming," by Blum and Hogaboom, good results have been obtained by controlling a brass plating solution at pH 12.

When a solution is neutral, that is at pH 7, very small additions of acid or alkali serve to cause a large change in its pH. But when a solution is at a low or high pH,(very acid or very alkaline), the same small addition of acid or alkali makes little difference in the pH. This fact does not exclude the possible value of pH control for these solutions; but it explains the relatively constant pH of cyanide solutions, and indicates one of the reasons why the subject has not been more fully studied.

Colorimetric and electrometric methods are available for the determination of pH. Indicators for the alkaline range that are available were studied in the application of the colorimetric method. Since cyanide solutions are often brown, it is difficult to apply this method accurately on undiluted samples, but future work may establish relations that will permit a colorimetric determination of pH on diluted samples. It may be possible to apply the hydrogen electrode, but the glass electrode is not a satisfactory tool for use in very alkaline solutions.

D. The Measurement of Polarization:

Polarization measurements have frequently been made by the Haring cell. The principle of this method is good, but the usual type of cell is not suitable for accurate measurements in cyanide solutions. First, the dimensional characteristics of the cell are not fixed, as the cell may warp, the solution level can not be accurately measured, and the electrodes themselves are subject to bending and may not be accurately spaced. Second, the solution is exposed to the air. In cyanide solutions, particularly, this may be a possible source of error in polarization measurements.

To overcome these difficulties a cylindrical cell having sealed-in platinum electrodes has been designed and constructed. It is possible to calibrate this cell and thus obtain more accurate and reproducible measurements of conductivity and polarization. Furthermore, since the solution is completely enclosed except for small ports for emptying and filling, it is possible to control the atmosphere over the liquid.

We are now engaged in studying the operation of this cell. The results to date are encouraging. The values of polarization and conductivity which we have obtained on cyanide solutions are reproducible, and equilibrium is reached more quickly than with the open type of cell. A paper on this cell, including its details of construction and the results obtained with it on some cyanide silver solutions will be available at an early date.

DR. SODERBERG: There is one question I would like to ask. Did the free cyanide in the silver solution decompose approximately at the same rate as sodium cyanide alone for the same concentration?

DR. BLUM: The free cyanide as defined by the ordinary titration with silver in the presence of iodine is not decomposed at the same rate. Let us illustrate. Suppose we take two solutions, one of them is half normal sodium cyanide; another one is, we will say, half normal double silver cyanide plus half normal sodium cyanide. When we pass air through those, if we have half normal free cyanide we expect them to decompose at the same rate. They do not. The one containing the silver decomposes at a slower rate. If we find how much of this is present and how much free cyanide is left, then we find that that solution decomposes at the same rate as a solution of three-tenths normal silver cyanide. In other words, if within the limits of the experiment we find out that that calculation is correct, it confirms the fact that this compound is present there in an amount which leaves free cyanide to decompose at the same rate as true cyanide. I think it is a very useful method of attack even though it is not highly active.

DR. SODERBERG: During this passage of air would you effect a change just the same? That would still limit that method considerably.

DR. BLUM: It limits the method in the sense the results are more reliable

during the first part of the run than they are during the second part, because if you keep on indefinitely you will reach a point at which you will no longer be able to draw on your hydrocyanic acid. The acid would not permit it to be carried out so the result is subject to that limitation, but during the first period when we have less than ten per cent decomposition we believe the results are approximately correct.

DR. SODERBERG: In any of this work have they changed their opinion regarding the effect of carbonates?

DR. BLUM: You understand that the only discussion I recall last year on the effects of carbonate is regarding the effect of alkali in producing or preventing the decomposition of cyanide. That is, of course, a definite and quite a quantitative thing that the addition of alkali to any cyanide solution will reduce the rate at which the cyanide is decomposed. That was as far as we went in our statements. The discussion last year then came around to the question as to whether the alkali was desirable or permissible in the bath. We have done nothing on that. That is a subject which must be considered on its own merits' In other words, if you have a particular bath, zinc or cadmium, then you have to find out how much alkali is permissible or desirable. Other things equal, the more you can carry in there the less cyanide you will use, but we do not attempt to say at this time and did not last year, although there was a discussion on the subject, whether the alkali was desirable or otherwise. We simply said it has that obvious advantage of reducing the decomposition of cyanide. Whether you can use it or not has to be found out by a study of that bath and its particular operation. I think that is the point you have in mind.

NOTES ON THE ANALYSIS OF ALKALINE TIN PLATING SOLUTIONS

M. R. Thompson (Read by Dr. William Blum)
At the Chicago Convention, 1933.

I. INTRODUCTION

THE work described in this paper covers the first part of an investigation of alkaline tin plating solutions of the stannate type. It is planned to include studies of current efficiency, polarization, throwing power and the specification of deposits.

There is at present comparatively little exact information available on the extent of tin plating, but it has been used for such purposes as the coating of automobile engine pistons, electric refrigerator coils, equipment for dairies, bakeries, canneries and laundries, and on certain kinds of hardware and jewelry. In addition, there is a large amount of tinning done by the related contact or immersion processes on small office and household articles, including pins, fasteners, buckles, buttons, etc.

An investigation of this subject is of interest for several reasons. This country produces no tin and it is important to utilize the

imported tin with efficiency and economy. There are practically no established specifications for electroplated tin coatings and there is already a need for such specifications. The bath generally used for tin plating is typical of non-cyanide alkaline solutions, and information concerning its operation will aid in understanding and developing such solutions for other metals than tin.

Industrial evolution of tin plating has naturally followed empirical lines. Excellent progress has thus been made, but continued improvement depends on research to explain the theory involved and to afford more exact analytical control. In these respects, comparatively little is known about tin plating.

The analytical control methods must first be studied, before the plating process itself can be properly standardized and the more fundamental studies, such as those on polarization, can be conducted effectively. In this way, the best solutions can be maintained so as to yield uniformly satisfactory deposits, which in turn will increase the field of usefulness of tin plating.

The analytical control of alkaline tin solutions is difficult, and in some respects may prove to be an insoluble problem. The chemistry of tin is quite complicated, as tin, like lead, zinc, aluminum, and a few other metals, is "amphoteric", that is, its compounds are soluble in both acid and alkaline solutions. Unlike the other metals mentioned, however, it also possesses different valences, a valence of two in stannous salts and stannites, and a valence of four in stannic salts and stannates. In addition, there is a marked tendency for tin to form colloidal and complex compounds.

Even though a plating bath is originally prepared from sodium stannate, some stannite is likely to form during operation, and the sodium hydroxide that is added or that is produced by hydrolysis will absorb carbon dioxide from the air to form carbonate. In a system containing stannite, stannate, hydroxide, carbonate and possibly other alkali salts, the determination and control of total or free alkali and pH are not simple.

The methods proposed have yielded promising results on synthetic solutions and are therefore suggested for tiral on commercial baths. The methods will serve equally well for the analysis of plating solutions or tin salts and for determining the weight (and thickness) of deposits. The electrolytic and volumetric procedures for tin which will be described are modifications of standard methods. The procedure for free alkali is different from

any yet noted in the literature. More complete data on the accuracy obtainable and a bibliography of each method will be published later.

II. ANALYTICAL METHODS

(*a*) *Total Tin by Electrolysis*:

Take a measured, or weighed sample, sufficient to afford about 0.5 g. of tin. First filter a solution if very turbid. With plating baths, the required amount will vary from 5 ml for a high-tin bath to as much as 100 ml for a low-tin bath. Transfer the sample to a 250 ml beaker. Add just sufficient hydrochloric acid (sp. gr. 1.18) to redissolve any precipitate formed on acidifying and then about 10 ml excess. Unless all the tin is known to be in the stannic state, slowly add saturated bromine water (containing two or three per cent of bromine) until all of the stannous tin is oxidized and a reddish color indicates a slight excess. Destroy this excess by adding a few small crystals of hydroxylamine hydrochloride.

Add about 4 g. additional hydroxylamine hydrochloride, make up with distilled water to a volume of about 200 ml, warm to about 35°C and electrolyze for one hour, with about 2 amperes. Agitate the solution by means of a rotating anode or otherwise. Use a platinum wire anode and a weighed platinum or copper gauze cylindrical cathode 4 or 5 cm in diameter and 5 cm high.

When deposition is complete, remove the cathode quickly and carefully, rinse several times with distilled water, then once with alcohol, dry in warm air, cool and weigh.

Total tin (g/l) + Weight deposit (g) x 1000 ÷ volume sample (ml)

The deposit is dull gray in color and rather tough and crystalline, but less so from stannic chloride than from stannous chloride solution. With care an accuracy of about 0.1 per cent is obtainable. Hydroxylamine hydrochloride serves as an anode "depolarizer" and prevents the evolution of chlorine, which would attack the anode and also interfere with deposition. Platinum cathodes are readily stripped in a few minutes by treatment with hot strong hydrochloric acid. Copper gauze cathodes should be used only once. Small amounts of alkali salts in the tin bath, such as acetate, fluoride, borate, etc., do not appreciably affect the result.

(*b*) *Total Tin By Volumetric Analysis*:

Prepare a standard 0.5 M solution of ferric chloride by weighing out 144 g. of C.P. ferric ammonium chloride ($FeCL_3.2NH_4$

$CL.H_2O$) crystals, which have been dried for several days in a desiccator over calcium chloride or sulphuric acid. Dissolve the salt in distilled water, add about 10 ml of hydrochloric acid (1.18) and make up to exactly 1 liter. For approximate results this solution may be used on the basis of 1 ml = 0.030 g. of tin. For accurate work, it should be standardized against tin of known purity in the form of weighed drillings or powder. This tin is dissolved in hydrochloric acid (1.18) over night on the steam bath. Or the (ferric) iron content may be determined by any standard method and the tin value computed as follows:

$$2Fe^{III} + SN^{II} = 2Fe^{II} + SN^{IV}.$$

Tin value (g/ml) = Iron content (g/l) x 0.001063

For the analysis, take a measured sample of solution (5 to 100 ml), or a weighed sample of the tin salt dissolved in a little hydrochloric acid, sufficient to afford about 0.6 g. of tin. Place in a 200 ml Erlenmeyer flask furnished with a device to partially close the top. A two-hole rubber stopper, or a one-hole rubber stopper having a slot cut in the side, or a small glass funnel with short stem may be employed. Dilute to at least 50 ml and, if alkaline, add just enough hydrochloric acid (1.18) to redissolve ahe precipitate formed. Add about 5 ml additional hydrochloric tcid and 0.8 g of pure powdered (at least 60 and preferably 100 mesh) iron. Preliminary tests may be necessary to determine the proper amount of acid and iron to use in a given case.

$$2\ Fe^{O} + SN^{IV} = 2\ FE^{II} + Sn_{O}$$

1 g Fe^{O} = 1.06 g Sn^{IV}

or 1 g Sn^{IV} = 0 94 g Fe^{O}:

Partially close the top of the flask with the perforated stopper or the funnel, and allow the tin to precipitate for about ten minutes, with occasional gentle swirling of the flask. Then heat the flask for about 20 to 30 minutes, until the excess iron and most of the tin have dissolved. Add about 10 ml more hydrochloric acid (1.18) quickly, making sure that any tin particles are washed down the neck of the flask. Heat a few minutes more until all fine tin particles are dissolved.

Remove the flask from the source of heat, open and rinse down the stopper and neck with hot distilled water and titrate quickly in the flask while it is filled with steam. Rotate the flask as the standard ferric chloride solution is run in from a burette. The end point is denoted by a permanent yellow or yellowish-green color and is distinct. The accuracy obtainable is about 0.2 per

cent. Small concentrations of alkali salts in the tin bath, such as acetate, fluoride, borate, etc., do not interfere.

Total Tin (g/l) = Volume ferric Chloride (ml) x tin value (g/ml) x 1000 ÷ volume sample (ml).

This procedure obviates the troublesome use of a carbon dioxide blanket and seal, so often recommended in volumetric methods for tin.

(*c*) *Stannous Tin by Volumetric Analysis*:

Take a measured sample, acidify with hydrochloric acid, heat and titrate as before with the standard ferric chloride solution, omitting the reduction by iron. As the stannous tin content is likely to be low, a larger sample than for total tin may be advantageous, probably 50 ml or more.

Stannous Tin (g/l) = Volume ferric chloride (ml) x tin value (g/ml) x 1000 ÷ volume sample (ml)

Stannic Tin = Total Tin - Stannous Tin.

Sodium stannate (g/l), $Na_2SnO_3.3H_2O$, = Stannic tin (g/l) x 2.25

(*d*) *Free Alkali* (NaOH):

The "free alkali" in a tin bath appears to be analogous to the "free cyanide" in the various cyanide plating baths.

In this work, attempts were made to titrate free alkali directly in the solution with standard acid, using various indicators to denote an end point that would exclude carbonate and stannate at a high pH. The results so far have been unsatisfactory.

The following procedure is suggested, in which the stannate and carbonate are precipitated and filtered off, after which the sodium hydroxide in the filtrate is titrated.

Take a measured sample of the solution, for example 25 ml, dilute to about 75 ml with distilled water, heat to about 70°C and add slowly with stirring sufficient (for example 50 ml) $\underline{N}$ strontium chloride solution (134 g/l of $SrC1_2.6H_2O$), to give an excess. Heat and stir a few minutes until the precipitate is well coagulated. Then filter through a hard paper (5.5 cm in diameter) on a small Büchner suction filter (5.6 cm diameter funnel and 250 ml flask), and wash the precipitate three times with warm water. Add a little strontium chloride solution to the filtrate to test for complete precipitation. Cool the filtered solution, add two or three drops of phenolphthalein indicator solution (one per cent alcoholic) and titrate at once with 0.2 $\underline{N}$ hydrochloric acid until the pink color disappears.

Free alkali (g/l of sodium hydroxide) = Volume 0.2 N hydrochloric acid (ml) x 8 ÷ volume sample (ml).

N Barium chloride (122 g/l of $BaCl_2.2H_2O$) can also be used, but gives slightly less satisfactory results. When stannite is absent, the method appears to be accurate to about 1 g/l of sodium hydroxide. Carbonate in large amount makes the precipitate more voluminous. As it is then more difficult to wash out all the sodium hydroxide, the result may be lowered. Acetate does not affect the result appreciably, while borate tends to give slightly high and fluoride low results.

Stannite is not removed, and if present a precipitate of stannous hydroxide appears before the end point. The amount of stannite (Na_2SnO_2) is likely to be relatively low. An arbitrary correction, corresponding to the combined alkali in this compound may be applied to the apparent result for free alkali by deducting 0.67 g/l of sodium hydroxide for each g/l of stannous tin present in the sample. Pending more exact information on hydrolysis in the complex system containing stannite, stannate, hydroxide, and carbonate, this is probably an acceptable correction.

(*e*) *Carbonate*:

Carbonate is introduced into the plating baths as an impurity in sodium stannate and by gradual absorption of carbon dioxide from the air by the sodium hydroxide present. No satisfactory simple method for the determination of carbonate has yet been found. It is probably best determined by evolving, absorbing and weighing carbon dioxide, as described in standard textbooks. This method requires an experienced chemist, but fortunately a determination may not be needed frequently. An excessive accumulation of carbonate can be detected by the difference in specific gravity between a new and an old bath, provided the concentrations of the other constituents are about the same.

(*f*) *pH*:

The most promising method for determining pH at present is by means of the hydrogen electrode, which also requires an experienced chemist. Further work will be required to ascertain whether the measurement of pH is desirable in addition to controlling the free alkali.

(g) *Other Constituents*:

Salts, such as chloride, and metallic impurities, such as lead, can be readily determined by the usual chemical methods. Salts

such as fluoride, cyanide, thiosulphate, acetate, and borate present much difficulty, and it is doubtful if certain of these substances can be satisfactorily determined. This is all the more reason for being sure of their exact function and value before employing them.

III. ACKNOWLEDGMENT

Acknowledgment is made to Dr. W. Blum, who directed this work and has furnished much helpful advice. (Applause)

CHAIRMAN HAY: Are there any questions you gentlemen would like to ask?

DR. BLUM: The point is that any sodium perborate or any other oxidizing agent added will immediately oxidize the tin from the stannous to the stannic condition, and then the only question is that of removing the excess of oxidizing agent which can probably be done by boiling. I think there would be no difficulty on that score. We use bromine actually to oxidize.

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EDWARD H. TINGLEY

ORGANIZATION AND INDUSTRY

By Edward H. Tingley
Secretary, National Association of Foremen, Dayton, Ohio.
"Reproduction forbidden without permission of author."

ORGANIZATION exists as a direct answer to a need of the social order. Whenever man comes in contact with his fellows to work out the betterment of his present state, some form of organization is necessary. And the more complicated society becomes, the more organization is required and the more carefully must the parts be fitted together.

Today the men in Washington are talking about national planning of mining, of production and of distribution. To accomplish this, a closely knit organization of all mills, factories and stores will be demanded — in fact, it cannot succeed without the most detailed organization.

But what is organization?

The factory man thinks of it as a group of people working together for the same owner or manager. The dictionary defines the verb "organize" — "to arrange a task in suitable parts so that it may be performed efficiently." If we take this latter viewpoint, the real purpose of an organization is the efficient performance of a task. Some organize a factory — the men, the machinery, the materials, the money, the sales force, the supervision — all for the purpose of doing work at a profit. And we all agree that if the organization cannot make a profit the factory soon must close and the organization is no more. The organization must have a purpose. Do you think your workers realize the purpose of your organization?

ORGANIZATION AND BUSINESS

Success in any business depends primarily on the human element. Without this factor no business can operate. Materials, machinery and money cannot, in themselves, produce wealth; men must be added to coordinate the whole and give life and direction to the inanimate things. This being true, it naturally follows that special care must always be used in the selection of people for the various positions in every part of the business. The most successful business men of our day acknowledge the

fact that their success is due primarily to their ability to select men, as assistants, as foremen and as workers on the machines, etc. The real executive is one who directs the efforts of men more capable in their specialty, than himself.

Unfortunately it is common practice for the average executive and foreman to give too little thought to the training of his men. Even if he should select carefully, he afterwards nearly destroys the value of the individual by not placing in him the right confidence and trust through responsibility.

The responsibility must be definitely outlined so that each subordinate knows the limits over which he has control and therefore will not cause friction with other executives by attempting to cover ground properly belonging to another.

Much of the real training of subordinates comes from the frequent association and consultation with their "boss," to get his advice and to get the inspiration by knowing his plans for the business or department. This man-to-man contact is most valuable if the relationship is one of frank discussion and the open-minded attitude on both sides. The big executive's job is to coordinate the work of all his assistants and to keep a true perspective before them at all times.

With the vast increase in human knowledge during the past decade, man is forced more and more to specialize in one subject and to apply himself diligently to secure a full working grasp of it in a lifetime. This brings satisfaction to the individual in the joy of being able to do some one thing well and the confidence in his ability to accomplish results. As a result of this, we find in industry today, the chemist, the tool designer, the accountant, the electro-plater, the metallurgist, the traffic manager, the sales expert, the personnel manager, the time study man and many other technical experts. No one would think of operating a modern business without the use of specialists in each division of the business. To get the benefits of the specialized knowledge of these many experts, it is necessary to organize them in a business in such a way that their combined knowledge can be focused upon the problems of the company. This is usually secured by employing such men in various division of the business when their abilities can be used in the problems of that division.

This tendency towards specialization is not only to be found in the ranks of the executive class, but it is also in evidence in the subdivision of labor among shop workers. Operations are sub-

divided and each motion carefully studied. This condition brings about the greatest necessity for careful organization on the part of foremen.

THE VALUE OF AN ORGANIZATION

How frequently we read in the annual financial reports of various businesses the importance attached to the value of buildings, equipment, land, orders on hand, inventory of goods in the factory and even the "good will" of the buying public, but where is the group of men that make up the organization, appraised at their true value? Of all the items for which money is spent, the most important is the organization of men that has made possible the proper use of the buildings, equipment and materials to produce profits. A good organization is the greatest asset a company can have. Andrew Carnegie said that if all his money, his mills and his equipment were taken away, but if he could retain his organization of men, he would reestablish himself in four years.

Before a successful organization can be created for any division or for the business as a whole it is necessary to establish definite policies that are to guide the business, to determine the degree of importance of each division and the capacity of the individual to be chosen to head each important group. Very frequently it is a good policy to build an organization to suit the individuals available rather than to attempt to mold the people to fit the organization.

PROGRESS AND ORGANIZATION

If I were to ask for a definition of Progress, no doubt there would be many and various answers. If I limited it to Progress in your own shop or your own department, what would you say? Is there any connection between progress and organization? Between progress and the kind of supervision you give your men? Between progress and the training of men to do better work?

In one large industry, the superintendent and foremen adopted as their definition of Progress: "To Make a Better Product at a Lower Cost." Do you agree? All of us want better automobiles, better radios, better houses, better everything or else we do not think the world is progressing. But along with *better* products we expect a *lower cost.* What about the N.R.A. raising the shop costs and insisting upon higher prices for our products? These temporary stimulants which attempt to change prices from a downward trend to an upward trend are necessary, but in the long run, the better product at a lower cost will win out and that company will get the business. Even with fixed selling prices

we can make progress by giving more quality for the same price. The N.R.A. doesn't promise us success in our business just because we are in business, but our products must still be attactive to our purchasers and render real service for the price. So it's the job of our own organization to continue to make progress today, tomorrow and the next day and the next year — how? by making a better product at a lower cost.

ORGANIZATION AND PROFITS

At the outset of this talk on factory organization, it was stated that the purpose of organization was to produce and sell goods at a profit. The goal of any organization should be to render a service to people in such a way as to yield a profit. It is usually true that the industry that serves best is very likely to be the most profitable. Henry Ford said that the making of a profit proves that your methods and product are right. So we can link service and profit and still not be transgressing the laws of good management or the golden rule.

Fitness to survive is measured by profits. Therefore if your company desires to continue to render a service to humanity and to provide work for its employees, it must continue to secure a profit or it will not be able to stay in business. The economic principle is very definite — any industry must receive a reasonable profit for its services or it will perish. Without profit capital is withdrawn, and without financial support, working capital is withdrawn, and without financial support, working capital for wages materials and equipment is not available. A lack of money renders a firm inactive.

This point of view every executive and foreman should keep before his men. It is an important understanding that should be passed on in the right sort of way. Waste in industry could be tremendously reduced if we could but educate the rank and file of industrial workers to a recognition of the direct relationship between profits and continuous employment. More than ever, it is now that we need to have every possible factory working to supply employment.

ELEMENTS OF A STRONG ORGANIZATION

If it is agreed that an organization is a collection of people, equipment, materials, buildings, money, etc., grouped for the purpose of rendering a service to humanity at a profit — what elements should we look for in a strong organization?

A strong organization usually has the following main features:

1. Proper selection and training of assistants and subordinates.

2. Good and sufficient pay for the post to be filled.

3. Not overorganized — too many people with too little authority.

4. Not underorganized — too few people to do the work involved.

5. Confidence in those under him, on the part of the executive in charge.

6. Good morale — proper company spirit and satisfied employees.

7. A correct and thorough understanding of individual responsibilities, the limits of the work to be done and the results to be secured.

DISCUSSION QUESTIONS

1. Is the small shop, well organized, just as efficient as the large factory?

2. Can the employees be equally well trained in either a large or small organization?

3. As a result of the depression, are many shops under organized? In what way?

4. What examples of progress in your department can you give?

5. What information would you like to have, so you could tell if your department was making a profit for the company?

6. Why should a foreman or higher executive delegate his authority?

7. In what way has your organization shown its interest in its employees — over and above its interest in the equipment, the product or buildings?

8. Do you believe the N.R.A. is giving more help to the big organization or to the little shop? Explain your belief.

GOLD ELECTRO-PLATING

By PAUL A. OLDAM
Foreman Electro-plater Shiman Mfg. Co.
Member Newark Branch

Read at Newark Branch Meeting, April, 1924

GOLD is a soft, malleable, ductile yellow metal, and alloys very freely with practically all metals. Due to its chemical inactivity it is able to resist decomposition by the atmosphere and most acids. With these and other factors borne in

mind, the craftsmen and scientists have broadened this imperishable metal to numerous fields of industry, e. g., jewelry, dentistry, surgery, electro-plating, etc.

The phenomenon of electro-plating was first observed in 1805 by Brugnitelli, however, it was not put to practical purposes until 1840 at which time the Elkingtons and Wright applied electro-deposited gold on articles in order to enhance their beauty and increase their intrinsic value. Since that time the industry attracted the attention of chemists, and due to their careful investigations and fostering of research, the art of electro-plating has been put upon a legitimate, recognized and remunerative basis.

The method of preparing gold electro-plating solutions are numerous, from the number employed, three methods are commonly used: (1) Manufactured compounds of gold are purchased in the form of gold chloride or, gold cyanide. The gold chloride is converted directly to a double cyanide of gold, or, dissolved in water, precipitated with ammonium hydroxide, to form the fulminate of gold, washed by decantation, then converted into the double cyanide of gold. Gold cyanide can be dissolved in water with a specific amount of potassium or sodium cyanide. (2) Porous cup method. A cathode of either zinc, copper, iron, carbon or nichrome in the form of a coil, sheet or tube is placed into the porous cup containing a concentrated solution of KCN, this is then placed into a solution of KCN twice the equivalent of gold to be reduced. Anodes of a desired karat and color are placed in the dilute solution of KCN. A current is then introduced and applied until a sufficient amount of gold cyanide is formed. (3) Metallic gold can be dissolved with aqua regia a mixture composed of 3-HC1-HNO_3, forming gold chloride and precipitated in water with ammonium hydroxide as originally described in the first method.

In order to have consistent successful deposits of gold, various chemical and physical factors are involved. It is essential that these factors be adhered to. The factors that necessitate attentive care are namely:

(1) Metal Concentration
(2) Free Cyanide Content
(3) Addition Agents
(4) Temperature
(5) Current Density
(6) Anodes

METAL CONCENTRATION

The main metallic constituent of gold electro-plating is gold. Various concentrations of gold are used, varying somewhat from 1 to 20 dwt. per gallon. The exact concentration is a matter of choice, depending upon the color, karat and thickness of deposit desired, and type of work to be plated.

Solutions having a low gold metal content produce deposits of a poor pale or dark color, depending upon the free cyanide in the solution. The throwing power and covering range is decreased considerable which can be experienced on objects of a deep recess structure. Evidently the efficiency of the solution is lower, due to the low metal ion concentration in the solution.

The results of gold electro-plating solutions having a high metal content are somewhat better. They produce better cathode efficiencies, that of covering and throwing power where the lowest current densities are used. Assuming that the deposits are rich in gold color, however they acquire a course crystalline structure. The limits of bright plating is reduced, due to the rapidity of the reduction taking place in the electrolyte, although low current pressure is applied. Heavy deposits can be secured, but need subsequent scratch-brushing or polishing for a coherent assurance of the deposit.

However, when different shades of gold color are demanded, or specified karat deposits are to be produced, other metals in the form of double cyanides are introduced into the solution namely; silver, cadmium, copper, palladium, nickle, etc.

When silver, cadmium, or silver and cadmium in the form of double cyanide are added to a fine gold solution in small amounts they produce green gold deposits. Very good green gold color deposits may be produced from a solution containing silver, however, the yielded deposit tarnishes in the presence of H_2S gas and general atmospheric conditions in a short limit of time. Cadmium when introduced into a gold solution, produces a fair green gold color, its resistance to tarnish is greater than that of silver, however it lacks the true green tinge and is not to be compared with gold plus silver deposits. In order to obtain an ideal green gold color and a deposit that will resist tarnish in moderate atmospheric conditions, it is best that cadmium be introduced into the solution until a favorable green color is produced, then a sufficient amount of silver is added to acquire the true green gold color.

Red gold color deposits are obtained by the addition of double cyanide of copper to the regular gold electro-plating solution. Provided that the governing factors are maintained, with specific amounts of copper cyanide used, many shades of the so-called red gold can be produced. The deposits obtained from gold plus copper formulation are frequently used when low karat deposits are desired and at times serve as an intermediate coating to milder and richer gold tones.

White gold deposits are usually obtained from solutions containing the double gold and nickle cyanide. The amounts of nickle cyanide used is far greater in proportion to any of the other metal cyanides used, due to nickle being electro-negative, and its inactivity to be deposited from cyanide solution. Cadmium cyanide is frequently used to decrease the metal concentration, consequently identical white gold color deposits are produced, but rather difficult to control as to the composition of the metal deposited. Presently white gold plating has little commercial demand. Incidentally it can be applied to baser metal prior to rhodium plating.

Pink gold and flesh gold color deposits can be produced by adding small amounts of nickle cyanide along with copper cyanide to a fine gold solution. Flesh gold shades may be obtained very easily by maintaining a specific temperature, current pressure and composition of the solution. However, much difficulty is encountered endeavoring to secure a pink gold tint. This particular tone depends on the agitation, temperature, current density, and other factors that the skillful operator may employ. Recent literature advocates the use of palladium chloride to a gold solution in order to obtain pink gold shades. Although palladium chloride is soluble in cyanide solutions and its properties as a resistance to tarnish are extremely greater than that of the other metals in solution, however it has its disadvantages namely; cost, and the difficulty to be deposited simultaneously in proportion to the other metals in solution. Palladium as an addition agent to gold solutions is really in its infancy, and requires extensive research to be deposited as an alloy in gold electro-plating.

Gold electro-plating is probably the simplest type of solution to operate, considering that fine gold is the only metallic constituent. When two or more metals are in solution and are to be deposited in accordance to a desired karat composition, there should be then no exaggeration as to the importance of a study

made to the position of the metals in the E.M.S. with their respective potential in cyanide solutions.

In the art of gold electro-plating the metals used are above and below hydrogen which in turn are defined as electro-negative and electro-positive. The metals that are electro-positive theoretically have a tendency to plate out much faster than the metals that are electro-negative. Gold which is very electro-positive will naturally plate out much more rapidly than the other metals present in solution. It is then a logical consequence that frequent additions of gold should be made to the solution, for the resulting deposit will always have a greater percentage of gold than the original formula.

The metals silver, copper and cadmium are also electro-positive in cyanide solutions. Their potential difference is relatively small as they lie close to one another. Provided that the potential difference between the metals is adjusted and maintained it is then possible that the resulting deposit will yield the metals in proportion according to the fixed ratio.

Nickle in a cyanide solution has many probabilities attached to it regarding its potential. Much doubt is concerned whether it is electro-negative or electro-positive to gold. However, as a theoretical consideration it is pointed out that it is a possibility, that by the formation of complex cyanides the metals can be reduced proportionally. This is due to an excess of cyanide whereby the potential of gold is reduced to the equivalent of nickle. It is then possible that the metals can be deposited simultaneously. However, not to any extensive limits.

FREE CYANIDE CONTENT

The other constituent in a gold electro-plating solution that is of importance, is the cyanide radical. Its function in the solution is two-fold. It is a solvent for the metals used, also, supports electrolysis to a good advantage. An excess of cyanide other than that in the soluble double cyanide of the metals, when added to the solution is called free cyanide. Free cyanide serves to prevent the formation of insulating films of insoluble single metal cyanides on the anode. Free cyanide can be introduced into the solution in the compounded form of potassium cyanide or sodium cyanide. Either one of the compounds can be used provided that the percentage of the CN radical is known.

Gold solutions having a low free cyanide content are less conductive, they produce dark mossy deposits, and decrease the

anode efficiency considerable. Consequently, a higher current pressure must be applied to bring about any favorable deposit.

Solutions that have a higher free cyanide content are somewhat better. They provide better anode corrosion when low current densities are used. Thicker deposits can be obtained with a fixed current density. However much trouble is encountered if the solution contains a high free cyanide content, a low metal concentration, along with a high current density. The resulting deposit would be blistered and nonadherent.

The exact amount of free cyanide to be added to a gold solution, depends on the kind of anodes used and the metal ion concentration. When the appropriate amount has been added it should then be maintained correctly.

ADDITION AGENTS

Addition agents are substances which, while not necessary ingredients, are intentionally added to the solution, to produce a beneficial change in the character of the deposit. The number of addition agents used in gold electro-plating are exaggerated, as they result with little or no improvements to the deposit.

The addition agents that do bring about some effect to the deposit and the condition of gold solutions, to be expressed briefly are the following: Sodium phosphate, acts as a conductor; when added in excess it stabilizes the solution. Ammonium chloride, also a conductor; frequently used in gold plating when nickle is present in solution. Potassium carbonate, potassium hydroxide, potassium ferrocyanide, produce rose gold effects. Arsenious acid, lead carbonate, or lead acetate plus sodium hydroxide, yield antique effects. Sodium bisulphite, acts as a brightener, but decreases the free cyanide content and a possible precipitation of the metals in solution if added in excessive amounts. Solutions having addition agents lend themselves to more attentive care, as the amounts added are usually small and confined to short periods.

TEMPERATURE

Another very important factor involved in gold electro-plating is the temperature. It is a mechanical factor that effects the conductivity of the solution, the crystaline structure and color of the deposit, also condition of the solution.

In operating gold plating solutions with a low temperature the noticeable effects are: the solution is less conductive, the de-

posits are of a pale or dark color depending upon the metals and metal concentration of the solution.

When high temperatures are used the results are that the desired color to the deposit may be difficult to obtain, as the increase in temperature affords some metals more than others to plate out faster, although low current densities are used.

Almost without exception, reactions and reductions proceed more rapidly as the temperature is increased. The free CN is converted to carbonates, also occasional additions of water are necessary, due to evaporation. Temperatures should be fixed to the current density used, so that uniform deposits are produced.

CURRENT DENSITY

Another governing factor in gold electro-plating is the current density. An electrical form of energy that is used to carry the metallic ions from their salts in solution to the cathode to complete the electro deposition of metals.

Although low current densities are usually used in gold plating, too low current densities should not be used which produce inefficient cathode results. High current densities are employed in more concentrated solutions, or at elevated temperatures.

Before allowing a current to pass through a gold plating solution it is advisable, that the free cyanide content, metal ion concentration and temperature should be adjusted to coincide with a suitable amount of current, as a fluctuation of the current densities used produce many variable shades of color on the deposit.

ANODES

The choice of anodes to be used in the process of gold plating is also an important item. The various anodes used can be termed as soluble and insoluble. The soluble anodes are: fine gold, alloyed gold, nickle and nichrome. Fine gold and the alloyed gold anodes have a tendency to increase the metal concentration in the solution. Nickle and nichrome anodes are slightly soluble, however, no deletorious results are encountered if they are managed properly. Platinum and carbon are the insoluble anodes, they do not go into the solution, and only act as the supporting electrode in electro-plating.

Fine gold, alloyed gold, and platinum, are the best type of anodes to be recommended. However, due to the objectionable price of the precious metals, the baser metal anodes may be used, but extreme precautions should be employed as to their maintainance in solution and to the deposit.

CONCLUSION

With the experiments undertaken it has been found that, results are more favorable when the metal concentration is about 4 to 6 pennyweight per gallon. Using .5 to 1.5 oz. per gallon of free cyanide was not objectionable. All the addition agents used yielded the desired effects. Temperatures ranging between 135 and 170 degrees. Fahr. were found suitable. Intermediate current densities of .3 and .6 amperes per square inch resulted satisfactorily. Gold anodes were the choice of the number used.

REPORT ON HEALTH HAZARDS IN THE PLATING AND POLISHING TRADE

TO CHICAGO BRANCH

Your committee has endeavored to get together some data on this subject together with such laws and regulations as it might find to apply within the State of Illinois.

There are very few regulations, all based on laws that are not modern nor in keeping with the progress of the industry.

Hence, the committee offers the attached outline of health hazards for your consideration when engaged in equipping, altering or enlarging the facilities of your plant. Where a definite regulation or law is known to cover a hazard the word (*law*) is noted after the hazard.

POLISHING AND BUFFING ROOM HAZARDS

1. Blower Ventilation (*Law*)
   (a) *Silicosis* is principal health hazard due to fine dust particles getting into workman's lungs. (T) or (P)
2. Proper mechanical arrangements will guard against undue fatigue which may cause accidents. (T)
3. Grinding operations require either goggles or glass protective devices to guard against eye injury. (T) or (P)
4. Polishing Lathes should have proper wheel guards. All tapered end spindle points exposed should be protected with safety nuts.

SANDBLASTING OPERATION

1. Ventilation (*Law*)
   (a) Silicosis (T) or (P)
2. Masks or goggles may be required.
3. Gloves to prevent undue skin abrasion.

PAINT, LACQUER, ENAMEL, ORGANIC SOLVENTS

1. Fumes may cause nausea, headaches, and in some cases a temporary anesthesia. (T) or (P)
2. Ventilation and special protection against fire hazard are required in some cases. (*Law*)

LABORATORY OPERATIONS

1. Adequate ventilation should be provided against fumes. *Never analyze any cyanide solutions requiring heating with acids unless ample ventilation is available.*

PLATING ROOM HAZARDS

1. Alkaline Cleaning Solutions.
   (a) Spray in air from strong alkali irritating. (T)
   (b) Splash on body causing burns. (T)
2. Acid Pickling Solutions.
   (a) Strong acid bright dips require ventilation. (*law*) (T) or (P)
   (b) Weak acid pickling solutions. (T)
   (c) Hydrofluoric acid. (T)
   Operators liable to severe burns.
3. All Cyanide Dips and Plating Solutions.
   (a) Splash or spray in mouth causes instant death.
   (b) Additions of *any mineral acid* generates fumes of prussic acid which, if inhaled, cause instant death.
   (c) Solution on hands of workmen causes painful slow-healing sores. (T)
   (d) Hot cyanide solutions must be vented. (*law*)
4. Chrome Plating Solutions.
   (a) Fumes and spray must be vented. (*law*)
   (b) Inhalation of fumes causes perforation of nasal septum. (T) or (P)
   (c) Solution on hands of workmen causes painful slow-healing sores. (T)
5. General Hazards.
   (a) Slippery floors may cause operators to fall — results (T) or (P)
   (b) Proper clothing and boots, aprons, masks, etc., should be provided where necessary.

T — Temporary injury. P — Permanent injury.

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The Abstract Section

EDWARD B. SANIGAR

THESE abstracts are mostly adapted, by permission, from "Chemical Abstracts", the references to that publication being given in the form — *C. A.*, **27**, 3402 (1933) *i. e.*, Chemical Abstracts, Volume 27, column 3402 in the year 1933. The name appearing at the end of the abstract is that of the abstractor. Abbreviations for scientific journals are those used by "Chemical Abstracts" (see *C. A.*, **25**, 6019 (1931)). E. B. S.

Platinum-plating on noble and base metals. EDMUND R. THEWS and RALPH W. HARBISON. *Chem.-Ztg.* **57**,980 (1933).—Platinum plating lasts longer than silver or gold. Relative costs are discussed, and the resistance to corrosion is reported. The methods are described and the present use of platinum-ammonium nitrite -Pt $(NH_3)_2(NO_2)_2$- is endorsed.

C. A. **28**, 2274 (1934).

The electrodeposition of rhodium. G. GRUBE and E. KESTING. *Z. Electrochem.* **39**, 948 (1933).—In a qualitative experiment, sulfuric, fluosilicic, perchloric and oxalic acids gave excellent rhodium deposits, and the baths could be regenerated by solution of freshly produced rhodium hydroxide. Current density-cathode potential curves and current yields for rhodium deposition are given for a hydrochloric acid solution of sodium-rhodium chloride (Na_3RhCl_6) at 20°C., 40°C., and 60°C., for rhodium chloride in oxalic acid solution at 40°C., for ammonium-rhodium phosphate solution at 50°C., for rhodium perchlorate solution at 20°C., 40°C. and 60°C., for rhodium fluosilicate solution at 20°C., and 50°C., and for rhodium sulfate solution at 20° C. The effects of excesses of the various free acids on the deposits are also given. The separation occurs with high polarization so that at relatively low c. d. the metallic deposit results accompanied by hydrogen evolution.

C. A. **28**, 2274 (1934).

The electrodeposition of metallic columbium and its separation from Tantalum. N. IZGARUISHEV and A. F. PREDE. *Z. Electrochem*, **39**, 283 (1933).— Metallic columbium was deposited from solutions in potassium hydroxide, oxalic acid and citric acid. The acid solutions gave the best current yield. For these solutions the best results were obtained with a current density of 0.1-0.3 amp./sq. cm. (93-280 amp./sq. ft.) and a temperature not below 80°C. Tantalum remains in solution and can be precipitated after the electrolysis as the oxide, Ta_2O_5. *C. A.* **27**, 3671 (1933).

The electrodeposition of columbium. II. N. IZGARUISHEV and G. E. KAPLAN *Z. Elektrochem.* **40**, 33 (1934); of previous abstract.—Metallic columbium is only partially deposited from solutions containing potassium hydroxide or oxalic acid. In the course of the electrolysis, compounds are formed which are not further decomposed. With citric acid solutions this action is complicated by the regeneration of the original solution.

C. A. **28**, 2274 (1934).

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Treated Paper or the like for preventing tarnishing of silverware. U. S. patent No. 1,946,508. February 13, 1934. A. E. THURBER and R. H. SHOLTZ (to Oneida Community, Ltd.) Same as Canadian patent No. 333,430. June 20, 1933.—Copper sulfate is added to paper pulp to precipitate the sulfur in an inactive form. The paper formed does not tarnish silver and other tarnishable metals. *C. A.* **27,** 4675 (1933) and **28,** 2483 (1934).

Coating silver to prevent tarnishing. U. S. patent No. 1,947,180. February 13, 1934. B. BART (to Precious Metals Developing Co.).—Silver articles such as tableware, prize-cups, etc., are provided with successive electrodeposited coatings of nickel, palladium and rhodium. *C. A.* **28,** 2279 (1934).

Electrolytic production of embossing foils of gold or other metals. U. S. patent No. 1,945,142. January 30, 1934. J. FICHTMUELLER.—Electrodeposition is effected on a highly polished metal supporting band, a backing substance such as gelatin or shellac is applied and allowed to dry on the deposited metal, the metal and backing film are stripped from the support, a facing film, such as one from "liquid cellulose," is applied and a portion of the backing film is dissolved and removed. *C. A.* **28,** 2279 (1934).

Electrochemistry of chromium. IV. O. S. FEDOROVA. *J. Gen. Chem.* (U.S.S.R.) **3,** 636 (1933; cf. *C. A.* **27,** 667 (1933).—A review of the literature on the theory of chromium deposition from aqueous solutions. *C. A.* **28,** 1930 (1934). S.L.MADORSKY.

Chrome-plating at low temperature with low current density. A. GUERILLOT and J. PIERSON. *Bull. soc. franç. élec.* **3,** 859 (1933): *Chimie & industrie* **30,** 1359.—The effects of the constituents of the bath were studied. Sodium dichromate gives slightly dull coatings at 15°C. and 3-5 amp./sq. dm. (28-47 amp./sq. ft.) Organic acids (particularly tartaric acid) give very bright coatings; their salts are less satisfactory. Cold plating can be carried out with certain sulfates, but the coating is not as bright as with hot plating. *C. A.* **28,** 1930 (1934).

Information for the user about chromium plate. MARVIN J. UDY. *Metal Progress* **24,** No. 6, 24 (1933).—Hard coatings require hard steel backing and a fine polish to give a low coefficient of friction. Electrical conductivity, heat conductivity, reflecting power, oxidation and corrosion properties are given. *C. A.* **28,** 1964 (1934). W. A. MUDGE.

Anodes for chromium-plating in solutions containing hydrofluoric acid. ERICH MÜLLER and JÓN E. VESTDAL. *Z. Elektrochem.* **40,** 14 (1934).—Lead is the only anode material which permits the trivalent chromium ions formed at the cathode to be oxidised to CrO_3 (hexavalent chromium ions). If fluoride-ions are present, the lead fluoride (PbF_2) which is formed during an interruption of the electrolysis increases the cell resistance. This resistance is eliminated by addition of 10-30% antimony or bismuth to the lead. (See also Monthly Rev. **20** No. 5, 58 (April 1934). E.B.S.) *C. A.* **28,** 2274 (1934).

Chromium plating. British patent No. 401,933. November 23, 1933. HENDERIK VAN DER HORST.—A hard wearing surface is provided on an internal-combustion engine cylinder bore, after it has been ground smooth, by electrolytically depositing thereon a coating of chromium of uniform thickness, a coaxial cylindrical anode of hard lead or steel, of diameter only slightly less than that of the bore being used, and the flow of current being strictly confined

to the cylinder bore and the part of the anode within it. With a plating bath containing 350 g. chromic acid (H_2CrO_4) per liter and 1% sulfuric acid, the current density and pressure are 30-70 amp./sq. dm. (280-650 amp./sq. ft.) and 3-5 volt, the current being preferably reversed for the first minute to ensure cleaning and degassing of the bore. After deposition, the block is heated to 150-300°C. for one-half to two hours to expel occluded hydrogen.

C. A. **26,** 2278 (1934).

Throwing power of zinc plating solutions. I. Relation between current density and current efficiency of zinc sulfate solutions. MASAMI NAKAJIMA. *J. Electrochem. Asso. (Japan)* **2,** 19 (1934). — The pH values of 0.5, 1.5 and 2.5 N zinc sulfate solutions have been determined and compared with each other. The colorimetric method gave, in general, higher values than the electrometric method. The effect of pH on the conductivity becomes greater with decreasing concentration of zinc sulfate. The estimation of the current efficiency verified the existence of basic salt in the deposit when pH was 5.4 and 4.4. In 0.5 N solution, a considerable amount of basic salt was found at higher pH values and lower current density, and the current efficiency was rapidly lowered with lowering pH; while in 1.5 and 2.5 N solutions the content of basic salt was less and the lowering of pH did not greatly affect the current efficiency; an increase in current density gave about the same current efficiency, and almost the same values for 2.5 N solution. On the basis of quality of deposit and current efficiency, 1.5 to 2.5 N zinc sulfate solution at 3.4 pH and 1-3.5 amp./sq. dm. (9-30 amp./sq. ft. E.B.S.) is recommended.

C. A. **28,** 1931 (1934). K. KOMDA.

Electrochemistry of the system aluminum bromide-cuprous bromide in toluene. V. A. PLOTMIKOV and Z. A. YANKELEVICH. *J. Gen. Chem.* (U.S.S.R.) **3,** 208 (1933); *Chimie & industrie* **30,** 857. — A study of the conditions of electrodeposition of cuprous-ions as a dense coating from solutions which have hitherto been considered unsuitable for this purpose. A complex is formed when cuprous bromide is dissolved in a toluene solution of aluminum bromide. This is confirmed by the following facts: cuprous bromide is insoluble in toluene, but dissolves to a considerable extent in the presence of aluminum bromide, a saturated solution containing one molecule of cuprous bromide for one molecule of aluminum bromide. Addition of cuprous bromide to the aluminum bromide solution generates a considerable amount of heat, and the color of the solution changes from light yellow to deep green. The toluene solution of the complex conducts electricity; the maximum conductivity (4.86×10^{-3} reciprocal ohms) corresponds to 36.1% aluminum bromide and 10.3% cuprous bromide, i. e., to two molecules of aluminum bromide and one molecule of cuprous bromide. The solution contains possibly a compound such as $Al_2Br_6 . CuBr . nC_7H_8$. On the other hand, a toluene solution of aluminum bromide has a very low electrical conductivity, while cuprous bromide itself is insoluble in toluene. When the solution is electrolysed with a platinum anode, copper is deposited on the cathode and bromine liberated at the anode. When a copper anode is used, refining of the copper takes place; the copper deposits on the cathode from univalent ions. In order to obtain a dense coating, a copper cathode must be used. The decomposition potential of the complex corresponds to 1.40 volt.

C. A. **28,** 1931 (1934).

Ductile electrolytic iron. U. S. patent No. 1,945,107. January 30, 1934.

J. R. CAIN (one-half to F. A. Eustis). — A solution of a ferrous salt such as ferrous chloride is subjected to electrolysis between a pair of electrodes, while the solution surrounding the anode is maintained separate from the solution surrounding the cathode by a porous wall, and the pH of the solution surrounding the cathode is controlled to maintain it at between 1.0 and 3.0. Apparatus is described. (Cf. Monthly Rev. **20**, No. 3, 36 (Nov. 1933). E.B.S.).

C. A. **28**, 2279 (1934).

Nickel anodes for electrolysis. German patent No. 591,373. January 20, 1934. (Cl, 48a. 4). The Mond Nickel Co., Ltd. — Nickel containing up to 0.25% of combined oxygen is mechanically treated, e. g., by rolling or hammering at a raised temperature below its melting point. A homogeneous nickel-oxide eutectic is obtained, which dissolves easily and uniformly in electrolytic baths. *C. A.* **28**, 2281 (1934).

Electrodeposition of alloys. I. Nickel-cobalt alloys. S. A. PLETENEV and V. V. KUZNETZOVA. *Z: Elektrochem.* **39**, 201 (1933). — The electrodeposition of cobalt-nickel alloys from acid solutions of nickel sulfate and cobalt sulfate, in which the proportion of nickel to cobalt is 15 to 1, has been studied. The influence of pH (kept constant during electrolysis by addition of sulfuric acid or ammonia), temperature, current density, velocity of rotation of cathode, and agitation by means of a stream of air, on the composition of the deposit and percentage of the total cobalt deposited, has been investigated. Under the optimum conditions (nickel 80, cobalt 5.33, gram per liter, current density 100 amp./sq. m. (9 amp./sq. ft.), pH = 3.5, 20°C, and 2000 cathode r. p. m.) 90% of the cobalt is deposited as a 41% alloy in 26 hours.

C. A. **28**, 2273 (1934).

New process for forming metallic coatings on aluminum or aluminum alloys. CH. BOULANGER. *Mém. comm. corrosion aéron.* 1930-31,80; *Chimie & industrie* **30**,833. — Aluminum can be electroplated with copper or nickel under definite conditions, but the use of the electric current is not indispensable for plating with metals below aluminum in the electromotive series. Coating is effected by the use of solutions of double or complex cyanides obtained by dissolving oxides, carbonates, phosphates, oxalates, etc., of the respective metals, or their simple or complex cyanides in sodium, potassium or ammonium cyanide or in a mixture of these. Solution can be facilitated by addition of sodium hydroxide, potassium hydroxide, ammonium hydroxide or alkali carbonates. The coating is obtained by simple immersion of the objects at a variable temperature and at various concentrations. The coating, which generally requires 15-20 minutes, ceases with the evolution of gas; its thickness depends on the time of reaction. The coatings are adherent and can be superposed by successive action of solutions of simple cyanides, or can be obtained simultaneously in a single reaction by the use of a complex cyanide. The whole or any part of a given surface can be coated. Only a rather thin coating can be produced. (*C. A.* **28**, 1963 (1934). A. PAPINEAU-COUTURE.

Anodic coating of aluminum. French patent No. 755,890. December 1, 1933. Aluminum Colors Inc.) The temperature is maintained practically constant at all points of the electrolyte by bubbling air through it.

C. A. **28**, 1936 (1934).

Electric oxidation of aluminum. The Eloxal method. J. LOEWENTHAL. *Teknisk Ukeblad* **80**, 561 (1933). (See Monthly Rev. **20**, No. 3,33

(Nov. 1933). E.B.S.). — An electrolytic method is described for the coating of articles of aluminum or aluminum alloys with a 0.02-4 mm. film of v-oxide. As a rule, alternating current is employed, and no counter-electrodes are necessary. Articles of limited size are treated in rubber-lined, sheet-iron vats at a temperature of 15-30° C. In most instances 3.5-4.5 kilowatt hours per square meter surface will be sufficient, the treating being completed in 15-20 minutes. Wires or ribbons are drawn continuously through the bath. Tube, spirals and similar articles that can not be treated in the bath are treated by a special spraying apparatus, the article being grounded and serving as one electrode, the electric current playing between the sprayed surface and a counter electrode on the spraying apparatus through the jet of electrolyte. The latter is an acid solution containing oxidising substances, no further details being stated. The oxide film can be colored by treating with solutions of organic or mineral dyestuffs. The oxide film obtained by the eloxal method is claimed to be far superior to other oxide coatings with respect to electrical resistance, non-porosity, and chemical resistance. *C. A.* **28,** 2275 (1934).

Coating aluminum. British patent No. 401,579. November 16, 1933. P. R. L. HOGNER (to Aluminum Colors, Inc.). — A hard, wear-resistant, adherent oxide coating is produced electrolytically on a printing plate formed of aluminum or aluminum alloy. The plate forms the anode in a cell containing a 5-10% sulfuric acid, or a 3-5% chromic acid (H_2CrO_4) or oxalic acid solution, a current density of 10-20 amp./sq. ft. being used for 30 minutes at 20-30°C. *C. A.* **28,** 2279 (1934).

Aluminum cooking vessels. U. S. patent No. 1,946,149. February 6, 1934. H. V. CHURCHILL (to Aluminum Co. of America). — A coating resistant to long and repeated exposure to the action of corrosive foods such as salted hams comprises an adherent absorptive oxide coating in which is absorbed a substantial amount of a corrosion-inhibiting soluble sodium silicate having a ratio of SiO_2 to Na_2O of at least 3.25. *C. A.* **28,** 2313 (1934).

Coating aluminum. U. S. patent 1,946,148. February 6, 1934. MARTIN TOSTERUD (to Aluminum Co. of America). — An absorbent amorphous oxide coating is produced on the metal by anodic oxidation, substances such as coloring material are adsorbed on this coating and the permeability of the oxide coating is then reduced by treating in water at a temperature of 80-100° C. U. S. patent No. 1,946,150 relates to producing white coatings on aluminum or its alloys by forming on the metal surface an adherent oxide coating and subjecting this coating to a non-electrolytic treatment with a solution of an acid such as nitric acid, sulfuric acid or hydrofluoric acid. (Cf. Monthly Rev. **20,** No. 4, 38 (Dec. 1933) and No. 9, (May, 1934). E.B.S.) *C. A.* **28,** 2318 (1934)

Coating aluminum and its alloys. U. S. patent No. 1,946,147. February 6, 1934. H. BENGSTON (to Aluminum Colors, Inc.). — A pervious and absorbent oxide coating is formed on the surface, composed in substantial part of amorphous aluminum oxide, and the coated metal is treated in water at a temperature of 80-100° C. in order to convert the coating into an impervious, hard, crystalline form. (Cf. preceding abstract and Monthly Rev. **20,** No. 8, 56 (April, 1934). E.B.S. *C. A.* **28,** 2318 (1934).

Protecting or decorating aluminum surfaces. French patent No. 757,147. December 20, 1933. E. APART. A deposit is obtained on aluminum

by solutions of halides of zinc and tin acidulated with hydrofluoric acid, the solutions being about 3° Baumé. *C. A.* **28,** 2318 (1934).

Protecting aluminum from corrosion. U. S. patent No. 1,946,151-2. February 6, 1934. J. D. EDWARDS (to Aluminum Co. of America). See Canadian patent No. 335,209 (See Monthly Rev. **20,** No. 5, 26 (January. 1934). U. S. patent No. 1,946,153 relates to a process in which an absorbent oxide coating is treated with a silicate solution such as a sodium silicate. (Cf fourth abstract above.). *C. A.* **28,** 2318 (1934).

Prevention of corrosion of aluminum and its alloys. Japanese patent No. 100,100. March 14, 1933. The Minister of Navy (Masahiro Tazaki, inventor). — Aluminum or its alloys are made corrosion-proof by passing alternating or direct current into a fused alkali nitrate with the metal as the anode (if direct current is used) or the two poles (if alternating current is used). *C. A.* **28,** 2318 (1934).

Chlorate stains. H. KRAUSE. *Oberflächentech.* **11,** 1 (1934); of *C. A.* **26,** 4571 (1932). — Solutions containing potassium chlorate or sodium chlorate for coloring copper and its alloys are reviewed, their chemical action is explained, and application and tints obtained are described.
C. A. **28,** 1964 (1934). M. HARTENHEIM.

Testing tin coating on soft sheet. FRITZ EISENKOLB. *Stahl u. Eisen* **54,** 109 (1934). — The thickness of the layer is determined by dissolving a weighed section in hydrochloric acid and titrating with ferric chloride. Lead is determined by electrolysis. Porosity is revealed by allowing pieces to stand in hot water for 21 hours, and testing for rust spots with potassium ferricyanide.
C. A. **28,** 2296 (1934). C. L. WILSON.

Electrolytic degreasing and the limits of its applicability. K. W. FRÖHLICH. *Mitt. Forschungsinst. Probieramt Edelmetalle* **7,** 111 (1934). — Certain irregularities and defects which were met in the plating of material which was formerly degreased by the electrolytic process are investigated. Especially copper and silver surfaces were subject to failures, and certain impurities were found to be the reason. Local development of spongy metal by hydrogen in the electrolytic process, impurities of oxygen and phosphorus in copper and silver (cuprous oxide and phosphide) are responsible. These conditions are discussed. If alloys (containing such impurities) are first immersed in a 10% boiling solution of potassium cyanide, cuprous oxide and phosphide are dissolved and a silver film is formed, an electrolytic degreasing can be applied. The same trouble was, however, not observed with nickel or chromium plating even if the same impurities were present. A number of etchings illustrate the conditions. (See Monthly Rev. **20,** No. 6, 25 (Feb., 1934). E.B.S.)
C. A. **28,** 1964 (1934).

Degreasing metal articles. British patent No. 400,997. November 6, 1933. J. SAVAGE and IMPERIAL CHEMICAL INDUSTRIES, LTD. — In degreasing with volatile solvents, the solvent vapors being condensed by water-cooled surfaces, the cooling water is warmed to above the dew-point of the atmosphere, whereby the condensed solvent is free from water. Apparatus is described. *C. A.* **28,** 1978 (1934).

The electrolytic etching process. III. The side-etching. MASATAKA NAGANO. *J. Electrochem. Assoc.* (Japan) **2,** 56 (1934); see Monthly Rev. **20,** No. 6, 26 (Feb., 1934). — The effects of etching conditions have been ex-

amined. The side-etching may be reduced by an average of 30% by applying electrolytic etching instead of chemical. Thus side-etching is decreased when a copper surface is electrolysed in 2.5 N potassium nitrate solution acidified with 2 N acetic acid, with a current density of 2 amp. / sq. cm.; similarly for a zinc surface in N ammonium chloride with a current density of 3 amp./sq.cm.

C. A. **28,** 2276 (1934). K. KONDA.

Theory and systematization of the corrosion of metals. GERHARD SCHIKORR. *Mitt. deut. Materialsprüfungsanstalt.* Sonderheft **22,** 3 (1933).— A comprehensive discussion of the different types of corrosion, particularly of irregularities unexplainable by prevailing theories. A division of corrosion types, according to whether the rate of corrosion is determined by the anodic or the cathodic reaction, is outlined.

C. A. **28,** 1972 (1934). LEOPOLD PESSEL.

Resisting hydrochloric acid corrosion with metals. F. A. ROHRMAN. *Chem. & Met. Eng.* 40,646 (1933). — A discussion of the alloys found acceptable for contact with hydrochloric acid.

C. A. **28,** 1972 (1934). LEOPOLD PESSEL.

Absorption of hydrogen by iron. FRIEDRICH KORBER and HEINRICH PLOUM. *Z. Elektrochem.* **39,** 252 (1933). — Absorption of hydrogen by iron, when the latter serves as cathode in the electrolysis of aqueous sulfuric acid, or when it is dissolved in sulfuric acid, occurs only in the presence of catalysts, of which the most powerful are sulfur (especially as hydrogen sulfide), arsenic, phosphorous and other elements which form volatile hydrides. Nickel and mercury have a slight catalytic action; copper and silver none at all.

C. A. **28,** 2273 (1934). BRISISH CHEM. ABS.

Dispersion of electric current in electrodeposition. M. A. RABINOVICH and S. YA. PASECHNIK. *Ukrain. Khem. Zhur.* **8,** Wiss. tech. Teil 127 (1933). — A brief literature survey and the experimental work show that dispersion of electric currents in electroplating, which results in a non-uniform deposition of metals, is due to local overvoltage because of the differences in smoothness of the surfaces of processed articles.

C. A. **28,** 2274 (1934). V. A. KALICHEVSKY.

Protecting metal wires, etc. French patent No. 756,505, December 11, 1933. DÉSIRÉ BAUDEWYNS. — Wires, etc., are protected against oxidation by passing them in a continuous manner into successive electrolytic baths to deposit thereon successive layers of different inoxidisable metals. Washing baths are placed between each electrolytic bath to remove electrolyte.

C. A. **28,** 2279 (1934).

Coating objects with metals. French patent No. 755,713. November 29, 1933. Le Syndicat Jacquemin. — To protect objects of glass, wood, paper, porcelain, etc., against the atmosphere or other destructive agents, they are made conductive, to electricity by treatment with a varnish paraffin or wax containing graphite and are then covered with zinc, lead, copper, tin, cadmium, cobalt, chromium, nickel, gold or silver electrolytically. *C. A.* **28,** 1936 (1934).

Filtration of plating solutions. LOUIS WEISBERG and WILLARD F. GREENWALD. *Metal Ind.* (N. Y.) **32,** 15 (1934). — A discussion of filter, pumps and materials of construction. *C. A.* **28,** 1893 (1934). P. S. ROLLER.

Portable electrode for plating by direct application. British patent No. 400,510. October 26, 1933. A. E. NEWEY. C. A. **28,** 1936 (1934).

Dental plates and like articles of metal alloys. British patent No. 400,089. October 19, 1933. S. LOOS. — Articles made of alloys, which are required to fit closly an uneven surface are made by depositing on a mold, e. g., by electrolysis or spraying, a large number of thin layers of the constituent metals. Diffusion of the metals takes place that may be completed by heating. Dental plates and plates for replacing portions of skull bones may be so made. *C. A.* **28,** 1981 (1934).

Electrodeposition of shellac. NARASIMHA MURTY and M. SREENIVASAYA. *Chemistry & Industry* 1934, 35. — A preliminary notice. During electrodialysis of an alkaline solution of shellac it was observed that a shellac micelle can carry a negative charge. Shellac was deposited on a platinum anode from various alkaline solutions. In the presence of chloride-ions and sulfate-ions polymerization took place. *C. A.* **28,** 1931 (1934). J.H.M.

ABSTRACTS FROM THE EDUCATIONAL COMMITTEE

T. F. SLATTERY, Chairman.

The Plating of Castings — B. Caplan
Synopsis of an article published in Metal Industry (London) March 23, 1934, page 327

Successful and economical plating of castings depends to a great extent on the quality of the casting. Porous and dirty castings are all too frequent, and cause the polisher and plater no end of trouble. With non-ferrous castings, it is sometimes necessary to pickle and tin the castings to fill the pores.

Iron and malleable iron castings are prepared for plating by first grinding on a 60/90 carborundum wheel at 1,800 rpm. and then bobbing with 120/140 emery on a felt bob. Brass and bronze castings are dipped in caustic and then pickled, first with weak hydrochloric, then with nitric acid. After thorough rinsing, they are dried, buffed with 120 emery, and finished with tripoli.

All cleaning is done electrolytically, and contamination of caustic cleaners by solder must be guarded against. Iron castings are placed in a hot alkaline cleaner, using 6 to 8 volts. They are then pickled in strong hydrochloric acid for several minutes to remove oxide and to etch the surface slightly. After rinsing, they are replaced in the alkaline cleaner for a minute to kill the acid, are again well rinsed, dipped in 10% sulphuric or tartaric acid, and placed in the nickel plating bath.

If the work is to be chromium plated, an anodic acid cleaner consisting of 50° B'e sulphuric acid is used. 15 to 20 seconds at 6 volts is enough. This step is so rapid that the pieces are then usually stored by hanging in the 52 Cyanide cleaner after thorough rinsing. When wanted, they are rinsed, acid dipped, and plated.

Brass and bronze castings are also cleaned electrolytically in a hot alkaline cleaner, but the current is reversed for 15 to 30 seconds just before removing. They are then anodically etched in 5% cyanide solution at 4 to 5 amperes for 2 or 3 minutes, well rinsed, dipped in 10% sulphuric, and nickel plated.

Nickel plating is done in a bath composed of nickel sulphate magnesium sulphate, sodium chloride, and boric acid. The actual proportions used are not stated. The bath is operated at 30° C with pH 5.6. It is agitated and filtered. Depolarized anodes are recommended as superior to cast or rolled anodes.

One-thousandths of an inch of soft ductile nickel is obtained in 20 min. (This would require a current density of 60 amperes per square foot). After plating, the work is rinsed and hung in clean boiling water, from which it dries rapidly on removal. The procedure used in chromium plating is not given.

By the methods described, 200 pieces have been plated daily with only 15 strips in three months. These were due to double deposits or to soldered joints.

C. T. THOMAS

Nickel-Chromium Plating Technique

Maurice Cook and B.J.R. Evans

Metal Industry (London) March 9,1934, page 279 and March 23,1934, page 329

Because of the superior appearance and finish of chromium, it is now common practice to plate 0.0001 in. of chromium over 0.001 in. of nickel in many cases where nickel alone was formerly used. Various problems were presented by this change in procedure.

Before this change, work from the polishing shop was wired, placed in a hot alkaline cleaner made up of soda ash and sodium silicate for 20 to 30 min. transferred to an electrolytic cold cleaner containing caustic soda and potassium cyanide, for 3 to 5 min., scoured with pumice, rinsed well, and then plated. Nickel ammonium sulphate baths were used, and additions of sulphuric acid or ammonia were made as the appearance of the deposit indicated the need thereof.

With the advent of chromium plating, various changes in technique of nickel plating were found necessary because of such difficulties as stripping of deposits, Hand scouring of work has been eliminated. All work is degreased in a vapor cleaner, such as the trichlorethylene cleaner, when it comes from polishing. After this, it is placed on racks, the exposed parts of which are rubber insulated. All non-ferrous metals are cleaned in a hot electro-alkaline cleaner for 3 min.

Both the ferrous and the non-ferrous work is given an anodic etch, the ferrous in a strong sulphuric acid solution of 60°B'e for one minute, and the non-ferrous in a bath containing 20 g/l of acid ammonium citrate, operated at 45 amp/sq. ft. for 30 sec. After thorough rinsing in cold water, the work is then plated.

The plating is done in a bath containing 50 g/l nickel, 7.5 g/l chloride, 20 g/l boric acid, operated at 35° C, with a pH of 5.5 to 5.7 and a current density of about 30 amp sq. ft.

The nickel deposit is rinsed, dried, and mopped before chromium plating. The rubber insulated rack is not suitable for use in the chromium bath. This bath is contained in a steel tank faced inside with 7% antimony lead and lined with glass. This tank is placed in a water bath heated by steam coils. The bath contains 250% to 280 g/1 of chromic acid with a sulphate ratio of 130:1. It is operated to 40°C with a voltage of 4.5 to 8v. The ratio of iron concentration to chromic acid concentration should not exceed 3.8%. The final rinsing after plating includes a hot soda rinse.

All additions to solutions and all operating details are under technical control. A strict record is kept on all scrap work, which averages less than 0.1% on ferrous work, and about 2% on non-ferrous work.

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DETROIT BRANCH

A regular meeting of the Detroit Branch, was held at the Hotel Statler, on Friday evening, May 4, 1934, at 8:00 P. M. Col. Hanjosten, President, in the Chair; all officers being present, as well as a good attendance. The Minutes of the previous meeting were approved by the Board of Managers before the meeting, therefore the reading of same was dispensed with.

Applications for membership reported by the Board of Managers as follows: Wm. B. Bowring, Associate; Louis Ralph Eastman, Associate; P. L. Amundsen, Active.

These were unanimously elected to membership in the Society; also the following were reinstated: Archie L. Burrows, Herbert H. Cross.

Nomination and election of officers then took place. Mr. W. W. McCord made a motion that, due to the fact that we were holding a Convention this year and the present officers were all well organized, that no change be made and that the entire force of officers be re-elected unanimously to hold over for the next year. This motion was regularly seconded and a unanimous vote was taken.

The next order of business was electing delegates to the Convention. They were elected as follows: Col. Hansjosten, Gordon Spencer, Geo. Kutzen, delegates. Eichstaedt, Woodmansee, and Wilson, alternates.

The President then introduced as the speaker of the evening, Mr. P. R. Pines, Research Chemist of the Harshaw Chemical Company, Cleveland, Ohio, who presented a paper on acid tin plating. This paper was very well read, very interesting and instructive. There was quite a discussion. Mr. Pines was kept very busy answering questions, showing that the attendants were interested in tin plating, and any question Mr. Pines could not answer, I have no doubt at all but that he will be able to answer them in the future. Mr. Pines was given hearty applause and a rising vote for the paper.

All Convention committees reported progress and are very enthusiastic on the results that we are sure of at this coming Convention.

T. C. EICHSTAEDT.

ACID TIN PLATING

By P. R. Pines, of Harshaw Chemical Co., Cleveland, Ohio

Due to the ease with which objects of base metals such as copper and steel may be immersed in a bath of molten tin, and receive a bright adherent coating, the subject of electrodeposition of tin has had little attention other than for the purpose of refining impure metal. With the advent of more precise manufacturing methods and high pressure production, a positive need for an electrodepositing process which would yield dense, smooth and firmly adhering tin deposits was keenly felt. Many baths were available yielding satisfactory results from the refiner's standpoint, giving dense deposits more or less smooth, which could be easily stripped from the cathode sheet and reworked into usable billets. These solutions were primarily designed to work at low current densities in the neighbor-

hood of five to ten amperes per square foot. This limitation has caused many of the worth while refiner's methods to fall by the wayside.

In 1929 the excellent work of Oplinger produced the first really important tin plating process applicable over the range of conditions found in job plating or large scale production. The process makes use of sodium stannate and caustic soda plus a buffing agent, usually sodium acetate, and an oxidizing agent, to maintain the tin in a quatravalent state. The process produces a very dense, firmly adherent deposit of tin, smooth and white up to and slightly beyond .001 inches in thickness. Above this point roughness is very often encountered, accompanied by loss of whiteness. The greatest difficulties encountered, however, are low efficiency, high voltage, high temperature and care of the solution. Theoretically the bath should deposit 1.1 (approximately) grams of tin per ampere hour. Under ideal conditions it rarely deposits in excess of .6 grams per ampere hour and under many conditions .4 grams per ampere hour, using a voltage of three to six, usually six, and a temperature from 158° to 176° F. Constant addition of sodium stannate is necessary to maintain the proper tin concentration and along with the sodium stannate, acetic acid or other suitable acid must be added in order to control the alkalinity, which control is very essential to good operation. Many operators obtained excellent results from this process. Others, however, found themselves greatly limited by the necessarily large units required to produce quantities of finished product. The result of this limitation was a further search for more efficient methods of operation.

From the efficiency standpoint, the most logical starting point for further work lies in the use of divalent tin compounds. Of these, the chloride and sulphate are the most common. Chlorides very quickly prove themselves to be unfit because of the increased tendency to produce irregular deposits, highly dendritic and of poor adherence, yielding stubbornly to the use of addition agents. Sulphates, however, are found to yield deposits of more regular structure, good adherence and yielding readily to the influence of addition agents or control agents. These sulphates were adopted as a standard beginning for developments of divalent tin plating baths.

It was found that stannous sulphate solutions with correct sulphuric acid concentrations were capable of producing efficiencies of 90 to 95% but that a satisfactory deposit could not be obtained without the use of control agents. The most useful of these were found to be Silicic acid, Hydrofluosilicic Acid, Pepsin, Glue, Aloin, Cresylic Acid, Cresol Sulphonic Acid, Benzene Sulphonic Acid and combinations of the above along with sulphates of potassium, sodium, magnesium, aluminum and ammonium. Many patents have been granted embodying the above agents. However, none of these addition agents were capable of high current density operation. In contrast to alkaline baths, the theoretical rate of deposition if 2.21 grams of tin per ampere hour and in fact 2.0 to 2.1 grams per ampere hour or thereabouts. The voltage required is very low, being .5 to 1.5 volts at a cathode distance of 4 to 5 inches. The temperature of operation is found to be best at normal room temperature or about 80° F. Thus, for the same power cost, many times the quantity of tin may be deposited from the acid solution as against the alkaline solution. The quantity is so great in fact and the rate of deposit so rapid that the previously mentioned addition agents experienced great difficulty in controling the crystal growth at greater than about 15 amperes per square foot.

In the year 1932 what is to my knowledge the first commercially successful acid tin bath was produced by the Harshaw Chemical Company, capable of operating at high current densities on continuous operation and giving uniform deposit of excellent color and adherence, and smooth up to a thickness in excess of .005 inches. The secret of the bath lies in the proper selection and manufacture of control agents for absolute control of crystal structure and cathode polarization. Leaving the more or less ill-defined history of tin plating, I will here attempt to give a few of the salient points in the operation of this bath which distinguish it from other baths and which contribute to its value as a successful commercial process.

1. *Efficiency.*— The bath develops an overall efficiency of approximately 98%. The anode efficiency is slightly in excess of the cathode efficiency, obviating the necessity for addition of stannous sulphate, but is sufficiently lower to prevent the bath building up in tin. To cite an instance from commercial operation, a 5,000 gallon bath was checked for efficiency after three months of continuous operation with no additions whatever. The efficiencies both anode and cathode, were found at that time to be approximately 100%.

2. *Temperature.*— Temperature of operation is best between 75 and 85° F.

3. *Current Density.*— With mild agitation 5 to 50 amperes per square foot; with good agitation such as air, 5 to 70 amperes per square foot.

4. *Voltage.*— Voltage ranges from .3 to 1.5 volts across a 4 inch anode to cathode distance.

5. *Addition Agent.*— This agent is stable, soluble, and exhibits wide variation in concentration. In other words, the addition agent is not critical and requires very little attention.

6. *Stannous Sulphate.*— The stannous sulphate and stannic sulphate should not exceed 6 ounces per gallon for best operation, giving a low initial cost per unit. Sulphuric acid is best operated between 6 and 8 ounces per gallon.

7. The throwing power is in excess of 200% measured by means of Dr. Pan's cavity scale. To cite instances of the unusual throwing power, concerns are now engaged in plating tubes of copper of a length of 6 inches, and ¾ inch inside diameter, and are depositing tin through the entire tube without recourse to stopping off of the exterior surface.

8. *Adherence.*— Under proper cleaning conditions and subsequent acid dipping, the adherence is excellent, showing no tendency to blister, peel or scuff off.

9. *Color.*— Silvery white with a bright undertone at all recommended current densities.

10. *Agitation of the Bath.*— In a still bath, deposits of .001 inches in thickness may be obtained up to 20 amperes per square foot. Under mechanical agitation, deposits of .0025 inches in thickness may be obtained at 40 amperes per square foot. Under air agitation, deposits of .005 inches in thickness may be obtained up to 70 amperes per square foot.

11. *Rate of Deposition.*— .001″/11½ min. at 40 amps/sq. ft.

To cite instances of commercial operation which will give you some understanding of the value of the bath, a small job shop operating in Cleveland, being in need of a small high pressured installation, obtained 50 gallons of the solution. For six weeks, approximately 1,000 square feet per day were plated in this solution and no additions were made to the bath, drag-out being compensated with tap

water and no adjustment of addition agent was necessary. At the end of this six weeks period, analysis showed that the bath components were still in exactly the same ratio as when the bath was made up.

A further instance — a job shop in Toledo has operated this solution for a year and a half and one addition has been made consisting of approximately two ounces per gallon of addition agent. The stannous sulphate concentration and acid concentration are today the same as when the bath was made up, the drag-out loss of sulphuric acid being the only thing corrected.

For barrel plating operation, the solution proves itself to be most excellent in deposits up to .005 inches in thickness which are being regularly produced as a commercial product. Outside sources after a very thorough check of the bath from their own standpoint have given us the following conclusions:

The optimum thickness of deposit is found to be .00025 inches, all plates above this showing no pin holes in the ferroxal paper test and giving excellent salt spray results.

Another concern in contrasting electro tin sheet with hot dipped sheet found that one and one-half pounds of tin per base box of 435 square feet of hot dip is equivalent to 6 ounces per base box of electro tin from a standpoint of pin holes and rust protection.

Believing more is to be gained by way of information in answering any questions that you would care to ask, I will not here attempt to enlarge upon the subject.

CHICAGO

The regular monthly meeting of Chicago Branch was held May 12 at the Atlantic Hotel. President E. G. Stenberg presiding and all other officers present.

F. J. Hanlon, O. E. Servis, H. A. Gilbertson were elected Delegates to the Detroit Convention. A. L. Slater, G. Westerburg, E. Bernhardt were elected Alternates.

The same Branch Officers were re-elected for another year.

Several members spoke on the proposed amendments to our constitution. Mr. O. E. Servis read the final report of the Health Hazards Committee, after which the committee was discharged with a vote of thanks from the entire branch.

Two of our members Jake Hay and John Lockerbie came a long distance to attend the meeting and we appreciated seeing them.

The meeting was then turned over to our Librarian who found the following questions in the box:

No. 1. *What causes Nickel plated die castings to show blisters after laying around for two weeks, these showed no blisters for the first few days?*

Answer. Many suggestions offered, but most blisters are caused by impurities in the casting.

No. 2. *What causes blotches to form on the surface in chrome plating?*

Answer. Poor cleaning or overheating.

No. 3. *What is a possible method of chrome plating molded Bakelite parts, other than old time method of metalizing?*

Answer. Spray with SCHOOP process, then polish, buff and chrome plate.

No. 4. *What becomes of sodium cyanide added to a cyanide copper solution? Sodium Carbonate concentration does not build up nor p. H. increase.*

Answer. Cyanide consumed in depositing the copper metal. About 2 lbs. cyanide to 1 lb. metal.

No. 5. *Wanted, a bright dip for whitening sand blasted stainless steel of straight 18% chrome.*

NO answer; other Branches please help.

No. 6. *What causes pitting in an acid copper solution?*

Answer. Lack of acid.

No. 7. *What is needed in a Nickel hot rinse water to prevent spots?*

Answer. Whale Oil Soap.

J. W. HANLON, *Sec.-Treas.*

HARTFORD-CONNECTICUT VALLEY BRANCH

A meeting of the Hartford, Conn. Valley Branch was held on Monday evening, April 23, at the residence of Mr. Jas. St. Pierre, 120 Judd St., Bristol, Conn.

The meeting was called to order at 8.30 P. M., with Past President Beloin in the chair. Minutes of the previous meeting were read and accepted. All communications were read and placed on file. Three bills were voted paid. The secretary made a financial report to the Branch. The secretary appreciates very much the response of the members in regard to paying up their back dues, so as to enable the branch to pay all of its bills before the end of the fiscal year.

It was voted to hold a joint meeting of the Hartford, Bridgeport and Waterbury branches, on Saturday, May 19th at the Hotel Garde, Hartford, Conn. Various committees in the three branches have been appointed and are working hard to make this first joint meeting a success.

After the business meeting, a very pleasant social hour was spent, made more pleasant by a very delightful lunch served by our hostess, Mrs. St. Pierre. The meetings that are being held at the homes of the members are proving very popular and are being more largely attended than any of our previous meetings in the past four years.

It was voted to voted to hold our May meeting on Monday, May 28th, at the Pequabuck Golf Club, Bristol, Conn. The members who are golf fans are invited to come early and play a round of golf before the business meeting in the evening. V. E. GRANT, Sec'y.

TORONTO BRANCH

April 23, 1934 meeting. As a direct result of reduction of dues we received one application for reinstatement and one application for active membership. This proves we have one or two live wires at work anyway. Attendance was — well we did not have to drag in extra chairs. Sam Finlay is back in Toronto again and we all hope Sam keeps in good health and a good job.

We discussed that old topic which has engaged and enraged many A.E.S. members during the past twenty years, —the advisibility of accepting good platers who have not been fortunate enough to hold the position of foreman for one year.

Question — What causes scum to form on surface of cold nickel solution over week end?

Answer — Several were of the opinion that boric acid caused the scum and that possibly the scum contained some iron hydroxide.

Question — How is water lacquer used?

Answer — Pass work through hot water and shake off excess moisture, immerse in water lacquer, drain and dry in drying chamber. Spray lacquering produces better protective film.

Tom O'Keefe has a very sore eye. Hcl did it.

A few of our members who have been idle are getting into new jobs.

W. S. B.

CLEVELAND BRANCH

The Cleveland Branch held its regular monthly meeting, Saturday, May 5, 1934 with Pres. H. J. TerDoest in the Chair. The minutes of previous meeting read and approved. The amendments submitted by Detroit

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Branch read and laid on table. All bills were ordered paid. Mr. Thompson read a paper on Organization and Industry. There was some good points brought out in the discussion.

The officers elected for 1934-35 were as follows: Pres., W. D. Scott; Vice President, Elmer Peterjohn; Secretary-Treas, Wm. E. O'Berg, 2191 W. 29th St., Cleveland, Ohio; Librarian, E. Steen Thompson; Board of Managers, J. C. Singler, L. F. Koehle, John E. Schmotzer; Delegates to Convention, E. Steen Thompson, J. C. Singler, Elmer Peterjohn; Alternates, L. F. Koehle, W. E. O'Berg, W. D. Scott. The meeting adjourned at 10.20 P.M.

WM. D. SCOTT, Sec'y

BRIDGEPORT BRANCH

The Bridgeport Branch held its regular meeting on Friday, May 4 at the Contract Plating Company. President Al Rosenthal, presided. The minutes of the last meeting were read and accepted.

Communications were read from the Department of Commerce, Mr. H. A. Gilbertson, and others pertaining to the Convention.

Election of Officers for the following year took place and the President, Vice President, Secretary, and Treasurer were reelected, respectively: Al Rosenthal, Herman Brown, William Flaherty, Librarian John Schneider, Board of Governors; Ben Kusterer, William Thompson, and John Oberender. Joseph Sterling was elected Sergeant at Arms.

Ray O'Conner, Joseph Sexton, and Tom Chamberlain were chosen as delegates to the Convention — Alternates; Joe Sterling, George Wagstaff, and Al Rosenthal.

The Treasurer's report was read and accepted, all bills were ordered paid.

WILLIAM FLAHERTY, Sec'y-Treas.

MILWAUKEE BRANCH

The regular meeting of Milwaukee Branch was held at Lipps Hall, N. 3rd and West Highland Ave. May 10, 1934. Meeting was called to order by Pres. Paul Krause. The application of Wm. A. Kuehl was received as an active member. Mr. Kuehl is employed by the Metal Ware Corp., Two Rivers, Wis. The following officers were elect-for the year 1934-1935, Pres. Pat J. Sheehan, Vice Pres., Dexter F. Rhodes; Sec'y-Treas., Frank J. Marx; Librarian, Henry Binder; Asst. Librarian, A. J. Hermanson; Board of Managers, Robt. Steuernagel, Dan Wittig, Jack Geissman and H. C. Jaeger. Delegates to Detroit Convention, Robt. Steuernagel, Pat Sheehan and Edw. Werner. Alternates, Ray Goodsell, Robt. Shaffer and Al Hermanson. Milwaukee has voted to have a picnic, for members and their families, and friends, some time in July. Date has not been set.

FRANK J. MARX, *Secy-Treas.*

WATERBURY BRANCH

At a meeting of Waterbury Branch, held Friday evening, May 11th, the following officers were elected for the coming year — President, Tennant Elwin; Vice-president, William Cavanaugh; Sec'y-Treas., Wm. F. Guilfoile; Librarian, Charles Nardozzi; Asst. Librarian, Ellsworth F. Candee; Board of Managers, Wm. J. Gray, Septimus Marland and Richard Crane.

Delegates to supreme convention, Wm. F. Guilfoile, Wm. Delage and

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Joseph McConas. Communication from Supreme Secretary, in connection with proposed amendments to Constitution, was read and commented upon. Communication from T. C. Eichstaedt, secretary of the convention committee, outlining the convention program, and calling for samples for exhibition purposes was also read. A delegation from the Hartford-Conn. Valley Branch was present and outlined the progress being made in the arrangements for the Educational Session and Banquet to be held at the Hotel Garde, Hartford, Saturday, May 19th. Waterbury Branch voted to co-operate with Hartford and Bridgeport Branches in making the affair a success.

WM. F. GUILFOILE, *Sec'y.*

ROCHESTER BRANCH

Rochester Branch held its regular monthly meeting on Friday night, April 20 at the Seneca Hotel Meeting presided over by President Kohlmeier.

After the reading of minutes of previous meeting the committee for the bowling party reported that they had secured Muhs Bowling Hall and that a very good response had been received thus far thereby assuring us of another of this Branch's successful parties. A motion was made by Mr. Hehr, seconded by Mr. Hart, that the secretary be instructed to pay all outstanding bills. Carried. The application of Mr. A. S. Groh was then read and accepted.

As guest of the evening we had Mr. Jack Pearsall of the Bruce Products Corp., who favored us with a short talk on the trend of business, which he said is very good. He also discussed at some length, some of the newer ideas in plating.

JUDSON R. ELSTER, Secretary.

BALTIMORE-WASHINGTON BRANCH

The Baltimore-Washington Branch held its annual election of officers on May 5 prior to an open meeting.

The officers elected are as follows: Alvin D. Fewell, President; Mathias F. Lassance, Vice President; Wendall P. Barrows, Librarian; Irvin H. Hahn, Secretary and Treasurer. We elected Amos Earl Judd member of Balto-Wash. Branch.

After the business session, the meeting was thrown open to any one engaged in electroplating or the preparation for electroplating. Mr. Geo. B. Hogaboom gave a very instructive talk — "What is Under the Plate."

This was followed by a general discussion among all the members and guests, after which refreshments were served and every one enjoyed a pleasant social hour.

The attendance was surprisingly large, and we consider it one of the best meetings of the season.

IRVIN H. HAHN, Sec'y-Treas.

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